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OFFICIAL PUBLICATION OF THE PROCEEDINGS, AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

American Dyestuff Reporter was founded in 1917 and the Textile Colorist and Converter (formerly Textile Colorist) was incorporated with it in January, 1949. Published every other Monday, by the **HOWES PUBLISHING COMPANY, INC.**, 44 East 23rd Street, New York 10, N. Y. **C. R. Howes**, President; **Ernest J. Finan**, Executive Vice-President; **Norman A. Johnson**, Vice-President & Treasurer; **Myron D. Reeser**, Vice-President; **C. Essenbreis**, Secretary.

Telephone SPring 7-9364

AMERICAN
DYESTUFF REPORTER

DEVOTED TO TEXTILE WET-PROCESSING

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AMERICAN
DYESTUFF REPORTER

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SOME ASPECTS OF THE USE OF 2,2'-DIHYDROXY 5,5'-DICHLORODIPHENYL METHANE AS A TEXTILE FUNGICIDE

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INTRODUCTION

ONE of the shortcomings of many of the treatments used to render cotton and other cellulosic textiles resistant to microbiological attack is the degree of color imparted to the treated textile by the chemicals used. For many uses, this fact is of no particular importance, since the treatments are frequently applied in conjunction with pigments which effectively mask the color produced by the fungicide. This is the case in treated duck used in paulins, vehicle covers and certain types of tentage. However, where it is required that the treated material be colorless, or where the fungicide is to be applied to a previously dyed material, the use of colored treatments is either ruled out or, in the case of dyed materials, subject to certain limitations with respect to their effect on the final color of the material. This is especially true in such items as webbing, certain categories of tentage, and more especially in awning and outdoor furniture fabric. For these reasons considerable effort has been devoted to the search for colorless fungicides, and the list of those so far put into commercial use comprises salicyl anilide; zinc naphthenate; 2,2'-dihydroxy 5,5'-dichlorodiphenyl methane, commonly known as "G-4"; certain simpler chlorophenols, eg, pentachlorophenol, zinc dithiocarbamate, zinc mercaptobenzothiazole (and the so-called synergistic mixture of these two); certain organic mercurials; dodecyl dimethyl benzyl ammonium naphthenate and, more recently, the zinc complexes of dehydroabietylamine and 2-ethyl hexoic acid in association with 8-hydroxyquinoline. To this list must be added the compound lauryl pentachlorophenate, which, although not used to any extent on this continent, is in fairly wide use in England.

Of these, salicylanilide and the simpler chlorophenols show generally unsatisfactory resistance to weathering, while zinc naphthenate, in addition to imparting an undesirable odor, leads to a fairly substantial weight increase (usually of the order of 5 %) in the treated fabric. The other two zinc compounds are useful ones, being well suited for use on fabric used in contact with rubber. The colorless organic mercurials have been used to a limited extent; this being undoubtedly due, at least in part, to their poisonous nature. The ammonium naphthenate compound has been used to some extent and is an effective fungicide, but lacks fastness to water leaching. The zinc complex of dehydroabietylamine, etc, is a comparative newcomer to the field and shows considerable promise *(1)*. There remains the compound 2,2'-dihydroxy 5-5'-dichlorodiphenyl methane, which is sold under a number of trade names and which has had a wide use, either by itself or in admixture with other fungicides, in the treatment of a variety of textile materials. It is probably the most widely used colorless textile fungicide.

Two of the major requirements of a textile fungicide are that it should not be readily removed from a fabric by water and that it should not accelerate the chemical breakdown of the fabric. Both of these requirements relate to the behavior of the compound when the cellulosic substrate to which it has been applied undergoes "weathering", the word being used to denote the overall effect of the complex chemical, physical and biological influences to which a material is subjected when exposed outdoors. Of these, the chemical effect of actinic radiation in producing oxidative breakdown of the substrate and the effect of moisture in causing loss of fungicide, and also, possibly, contributing to oxidative breakdown, are probably the most important.

The possible role of a fungicide in accelerating chemical breakdown of the substrate will depend on its ability (or the ability of its degradation products) to act as a sensitizer in promoting such breakdown through a photosensitization mechanism or, where the possibility of the formation of highly ionized acids exists, through a hydrolytic mechanism. Possibility of deterioration of the substrate through the first of the above mechanisms may exist with metal-containing fungicides, and through the latter mechanism in the case of organic fungicides containing halogen substituents, which may give rise to the corresponding acids through actinic breakdown or hydrolysis of the fungicides themselves. Thus, in the case of fungicides such as chlorophenols, which contain acid-generating elements, there is the possibility of hydrolytic attack on a cellulose substrate depending on whether or not, under conditions of weathering, appreciable amounts of acid are produced. And, in this connection, it should be emphasized that the formation of relatively minor amounts of such acids may readily lead to marked deterioration of the cellulose substrate. It is for this reason that in formulations such as the well-known FWWMR finish, widely used on this continent, provision is made for the incorporation of an acid acceptor to remove possible traces of hydrochloric acid formed by breakdown of the chlorinated paraffins which form a part of the flame-resistant ingredients.

In view of the desirable properties as a textile fungicide of 2,2′-dihydroxy 5,5′-dichlorodiphenyl methane —referred hereinafter as DDDM—it was of interest to determine whether this compound showed any appreciable tendency to accelerate degradation of a cotton substrate under conditions of outdoor weathering, and this paper presents data obtained in a study designed primarily to do this. It is a part of a wider continuing study, in the field of textile fungicides, undertaken for the Canadian Armed Services.

The literature contains a number of references to studies on the properties and uses of DDDM as a textile fungicide, many of these being contained in the annotated bibliography on this chemical recently published by Sindar Corp *(2)*. The following summary deals more specifically with observations relating to the effect of this compound on the cellulose substrate under conditions of normal use. Abrams (3) refers to DDDM, along with other chlorinated phenols, ie, chloro-2-phenylphenol, pentachlorophenol and 2,4,6-trichlorophenol, as tending to cause degradation of cotton fabric in an accelerated weathering test involving exposure to a carbon arc with periodic wetting of the sample. Barghoorn (*4, 5*) and Bayley and Weatherburn *(6)* obtained some evidence that the presence of the compound in cotton duck exposed to outdoor weathering resulted in enhanced tendering of the fabric. Block (7) referring to certain limitations of chlorinated phenol types of textile fungicides mentions their susceptibility to photochemical breakdown. The resulting increased damage to the fabric appears to be associated with the formation, by the compound, of hydrochloric acid as, when damage is noted, the pH of an aqueous extract of the fabric is found to have decreased. On the other hand, a number of other workers who have investigated the behavior of the compound when applied to cellulosic fibers refer to the excellent results obtained without any reference to undesirable tendering effects.

There is better agreement among investigators on the fungicidal properties of the compound, which have been shown to be good, and on the extent of its removal from fabrics during weathering, which has been shown to be considerable, unless protected by a binder, such as wax.

One of the difficulties encountered in evaluating fungicides by outdoor weathering procedures is the fact that, in most cases, there is a gradual loss of fungicide from the samples throughout the duration of the test. This is most apparent with the organic fungicides containing no metal and least apparent with some of the inorganic treatments, such as mineral dye (chromic and ferric oxides) and certain mixtures of metallic oxides, eg, those of copper and chromium *(8)*. This loss can be minimized to some extent by the use of a binder, such as a wax or resin, and, in fact, from a practical viewpoint, this is the way in which fungicides are most often used on textiles. However, in some cases, the presence of a binder is unacceptable for the use intended and in such cases a knowledge of the effect of the fungicide itself is required; and, in any case, it is of interest to have some indication of this effect in view of the complicating effects on cellulose decomposition of waxes *(6)* and possibly of some resins. If exposure of experimental fabrics is to be made without loss of fungicide, it is necessary to protect the samples from the effect of water by placing them behind glass or plastic having a high transmission to sunlight. Since this complicates the experimental procedure, and since the component of sunlight most likely to be involved in the degradative process is the near ultraviolet wave lengths, it seems reasonable to substitute a source of radiation of high ultraviolet content such as that provided in the Fade-Ometer or Weather-Ometer, both of which machines are in wide use. In the present work the latter machine, without water spray, has been used for this purpose, but outdoor exposures have also been carried out in three sites under different climatic conditions, viz, temperate, dry and jungle.

MATERIALS AND TREATMENT

The fabrics and treatments used in this study were as follows:

FABRICS———

Unbleached duck—An unsized army duck weighing 11.7 oz/sq yd (10 oz commercial designation) and having 53 3-ply warp and 43 3-ply weft yarns per inch.

Oxford Cloth—An olive drab vat dyed fabric weighing 8.2 oz/sq yd (9 oz commercial designation), and having 137 2-ply warp and 46 singles weft yarns per inch.

Dyed duck—An olive drab vat dyed fabric weighing 12.0 oz/sq yd and having 48 3-ply warp yarns and 31 2-ply weft yarns per inch.

TREATMENTS———DDDM is a powder, having a low water solubility and a limited solubility in hydrocarbon solvents. It can be dissolved in mixtures of solvents, eg, by dissolving in isopropyl alcohol, n-butanol or acetone and then diluting with a petroleum solvent, such as Stoddard solvent. It may therefore be applied from such a mixture or by the 2-bath method in which the compound is dissolved in a dilute solution of sodium hydroxide and applied to the fabric followed by treatment with acetic acid to precipitate the free phenol. The compound is also available in "solubilized" form, which permits it to be diluted with a relatively cheap petroleum solvent, eg, Stoddard solvent. The first and last methods of application were used in the present work, although reference is also made in it to data previously obtained with samples treated by the 2-bath method.

In the carrying out of treatments on the unbleached duck, strips of the fabric were first cut 6 x 18 inches, with the short dimension in the warp direction and randomized. They were then leached in water for 24 hours in order to minimize any shrinkage which might occur during weathering or soil burial, and the treatment carried out. A piece of fabric 6 x 3 inches was then cut from the selvedge end of each of the treated 6 x 18-inch pieces and all the small strips thus obtained from a given treatment cut up and well mixed for use in the chemical analysis for fungicide content.

The compound was applied at three levels amounting to approximately 1.0, 1.5 and 2.0% on the weight of the fabric. The treatments on the Oxford cloth and dyed duck were carried out commercially.

In the case of the unbleached duck, a duplicate set of treated samples containing a wax treatment was prepared. This treatment was applied from the same bath as the fungicides where a solvent treatment was used or as a separate treatment, from solvent, where the fungicide had been applied by a 2-bath aqueous treatment. The wax consisted of a mixture of paraffin wax and petrolatum in the ratio of 3:1 by weight, the total add-on being 10%. The characteristics of these materials have been previously described *(1)*.

The Oxford cloth and the dyed duck carried a water repellent finish of the wax-aluminum salt type.

TEST METHODS

Breaking Strength. This was measured on one-inch-wide ravelled warp specimens, which were broken on a motor-driven pendulum-type Scott Tensile Tester using 3-inch jaw spacing and a pulling speed of 12 inches/minute. The samples were conditioned at 65 ± 2% RH and 70 ± 2°F for

24 hours prior to testing. Ten breaks were carried out on each sample and the results averaged. In the case of the yarn samples, 25 specimens of each sample were broken and the results averaged. A Goodbrand tensile machine with jaws 10 inches apart and operating at a pulling speed of 18 inches/minute was used. Tests for significance of differences were carried out and variations in breaking strength losses shown in the data are significant at a 95% level of probability.

Chemical Damage. This was measured by the cuprammonium fluidity method. The reagent contained 15.0 ± 0.1 gpl copper and 200 ± 10 gpl ammonia (NH_3). The dispersions used contained 5% cotton previously conditioned as above, the measurements being made at 20 ± 0.1°C. Samples containing wax were solvent-extracted in a Soxhlet with benzene before testing.

pH Measurements. The specimens which had been used in the breaking strength tests on the yarns exposed in the Weather-Ometer and subsequently extracted with benzene for use in fluidity measurements were used to determine the degree of acidity of the samples after exposure. Five grams of yarn were cut into small pieces and extracted for 4 hours with 200 ml of boiled-out distilled water in an Erlenmeyer flask, at 50°C. The water extract was cooled and the pH determined using a Beckman glass electrode pH meter.

Content of Fungicide. This was determined by the method of Gottlieb and Marshall (*9*).

Leaching. Since earlier work (*6*) and data from the literature had shown that the compound was removed fairly rapidly in leaching and since the compound, being phenolic, is soluble in alkaline media, it was of interest to examine the effect of pH of the water used for leaching on the rate of loss of compound. This is an important consideration and one liable to be overlooked in laboratories carrying out routine leaching tests using tap water. In Ottawa, for example, the pH of the tap water is 7.9, or a degree of alkalinity sufficient to lead to loss of phenolic compounds from fabric. Small strips of the treated fabric were immersed in 3 liters of distilled or tap water at a fabric: liquid ratio of 1:300, for 24 hours at room temperature, with frequent stirring during the daylight hours. The samples were then thoroughly rinsed in a fresh lot of water and the content of fungicide determined.

TABLE I

Weather conditions at various exposure sites

Site	Period	Temperature (°F) Mean max	Mean min	Hours of sunshine	Rainfall (inches)
Ottawa	4 mos (14 June—14 Oct, 1955)	78	55	989	9.6
"	5 mos (1 May—30 Sept, 1953)	73	52	1202	13.3
"	4 mos (31 May—30 Sept, 1945)	81	56	920	16.8
Port Harcourt, Nigeria	6 mos (28 Dec—28 June, 1954)	82	73	—	37.5
Kano, Nigeria	6 mos (27 Dec—4 July, 1954)	95	68	1570	6.3

Resistance to Microbiological Attack. This was measured by means of the soil-burial test. Except where the effect of leaching was being specifically studied, the 6 x 15-inch specimens of the treated samples were tested without leaching since earlier work had shown that the relatively high rate of removal of compound caused by leaching made it difficult to relate the original contents of fungicide with the results of the burial tests. Otherwise the soil burial procedure was as previously described (*6*).

Exposure to Light Only. This was carried out in the Atlas Twin Arc Weather-Ometer without water. Warp yarns were ravelled, in order, from along a treated strip, fastened to runners at each end and suspended in the Weather-Ometer. Exposure periods of 4, 10 and 20 days were chosen on the basis of preliminary experiments with untreated fabric. Half way through each exposure period, the yarns were turned front to back.

Exposure Outdoors. Three outdoor exposure sites were employed. All samples were exposed at the Ottawa site. Strips of treated fabric 6 x 15 inches were sewn to runners and fastened to racks and set at an angle of 45° facing south, on the roof of the Applied Chemistry Building of the National Research Council Laboratories, Montreal Road, from June 14 to October 14, 1955. Samples of the Oxford cloth and of the dyed duck were also exposed in the undergrowth at a jungle site near Port Harcourt, Nigeria and at a semidesert site at Kano in the northern part of Nigeria.

At the end of the exposure periods, breaking strength measurements were carried out and fluidity determinations made on specimens of the original and weathered fabrics, any wax present on the specimens being previously removed by extraction with benzene. The content of fungicide in the weathered samples was determined.

DATA

The data for weather conditions during the outdoor exposures are given in Table I. The measurement of rainfall shown for the jungle site was not made at the actual location in which the samples were exposed, *i.e.*, in the jungle undergrowth, since such a measurement would be meaningless. It was made with a gauge located in a 90 x 36-foot clearing surrounded by trees 80-100 feet high. Such a siting of the gauge does not conform to the normal requirements that adjacent objects should not be closer to the gauge than a distance equal to twice their height.

EFFECT OF LEACHING ON LOSS OF COMPOUND. The data in Table II show that, as would be expected of a phenolic compound, leaching with tap water having an appreciable degree of alkalinity causes enhanced loss of compound. With the unwaxed samples the percentage loss of compound appeared to increase as the concentration on the sample was increased; with the waxed samples, the loss was unaffected by content of compound on the sample. Where the compound was applied from mixed solvents, the loss of compound was less than where applied in solubilized form. Moreover, contrary to the effect found in the mixed solvent application samples, the presence of wax did not reduce the loss of compound where the latter was applied in solubilized form.

Earlier work (*6*) had shown that, when applied by a 2-bath procedure, there was sufficient loss of compound on leaching in distilled water to give rise to a 60% loss of strength on a 2-week burial test for a sample containing initially 1% of the compound. This would correspond to a loss in excess of 50% since it has been shown that 0.5% of the compound gives complete protection in a 2-week soil burial test where there is no initial leaching of the sample. The same relative loss of compound is noted on weathering; for an initial concentration of approximately 1.0% applied from mixed solvents the loss was 68%, in solubilized form 85% and by the 2-bath method 98% on leaching. This difference is believed to be due to differences in degree of penetration of the fibers by the compound.

TABLE II

Effect of weathering (Ottawa 1955), burial, and leaching on unbleached cotton duck treated with compound

Treatment	% Compound	Breaking strength loss (%)				ΔF on weathering (rhes)	Loss of comp (%)		
		Weathered	Buried 2 weeks not leached	Leached & buried 2 weeks	Leached & buried 4 weeks		Weathered	Leached	
								Tap water	Dist water
Nonsolubilized, applied from mixed solvents	1.11	49	0	—	—	13.6	68	12	0
	1.58	49	0	—	—	12.9	62	20	10
	3.18	54	0	—	—	13.7	70	30	25
" + wax	0.95	68	8	—	—	10.5	86	7	0
	1.59	68	0	—	—	9.1	79	8	0
	1.85	64	0	—	—	8.2	71	9	0
Solubilized, applied from Stoddard solvent	1.21	49	8	—	—	13.9	85	23	10
	1.80	53	8	—	—	14.4	89	29	19
	2.37	49	8	—	—	15.1	65	37	32
" + wax	1.18	68	0	—	—	12.4	92	43	21
	1.60	68	0	—	—	10.2	92	46	25
	2.52	68	0	—	—	11.4	74	45	26
Untreated control	—	47	100	—	—	13.8	—	—	—
" + wax	—	68	95	—	—	14.2	—	—	—
2-Bath method (1945)	0.55	38	0	68	100	12.4	96	—	—
	1.00	45	0	57	100	12.9	87	—	—
" + wax	0.55	66	0	28	83	16.0	98	—	—
	1.00	69	0	0	15	17.4	91	—	—
Untreated control	—	42	100	—	—	13.5	—	—	—
" + wax	—	71	97	—	—	16.7	—	—	—

Note: Except where indicated, the data for weathering refer to exposures carried out at Ottawa, in 1955.

EFFECT OF OUTDOOR EXPOSURE———The data in Table II show that, in general, as indicated by breaking strength loss and increase in fluidity, there is little evidence that the presence of the compound accelerates the chemical breakdown of the fabric on weathering under the conditions obtaining during the 1955 Ottawa exposures. This was the case even with the highest concentration of the compound where the residual content of compound was still fairly high.

Attention is drawn to the apparently anomalous ΔF values for the waxed samples, in which the values for ΔF are generally *lower* and the breaking strength loss is *higher* than is the case in the absence of wax. These observations are in line with a large number of similar ones made, in this laboratory, in studying the effect of wax on the breaking strength of cotton fabrics subjected to weathering. It is believed that this relates to the fluidity-strength loss characteristics of the cellulose degradation products obtained without and with wax respectively. This will be the subject of a forthcoming paper.

The loss of compound on weathering is high and the presence of wax does not seem to decrease this loss. The same observation was made in the earlier work in which the 2-bath method of application was used.

FUNGICIDAL EFFICACY AS MEASURED BY SOIL BURIAL ———The data show that, where there is no leaching prior to burial,

TABLE III

Breaking strength loss and increase in fluidity of treated samples exposed in Weather-Ometer (without water)

Treatment	% Compound	Breaking strength loss (%)			ΔF (rhes)		
		4 days	10 days	20 days	4 days	10 days	20 days
Nonsolubilized, applied from mixed solvents	1.11	12	28	40	3.1	5.4	13.0
	1.58	12	28	67	2.5	5.3	15.5
	3.18	12	28	67	2.3	5.5	18.4
" + wax	0.95	40	56	71	6.5	9.8	19.9
	1.59	40	69	78	6.1	10.1	18.7
	1.85	49	69	78	5.6	10.3	20.9
Solubilized, applied from Stoddard solvent	1.21	12	40	60	1.4	9.4	17.1
	1.80	12	40	67	3.5	10.3	18.4
	2.37	12	40	67	1.6	10.6	19.8
" + wax	1.18	28	56	71	6.3	13.7	18.2
	1.60	36	69	78	5.3	16.1	20.8
	2.52	40	69	78	4.7	14.2	21.6
Untreated control	—	20	34	47	2.3	4.2	6.2

TABLE IV

pH of water extracts of samples treated with compound and exposed in Weather-Ometer

Treatment	% Compound	pH			
		original	4 days	10 days	20 days
Nonsolubilized, applied from mixed solvents	1.11	6.96	4.92	4.60	4.18
	1.58				
	3.18	6.50	4.68	4.18	3.92
" + wax	0.95				
	1.59	6.52	4.40	4.10	3.92
	1.85				
Solubilized, applied from Stoddard solvent	1.21	6.40	4.78	4.28	4.07
	1.80				
	2.37	6.70	4.75	4.14	4.02
" + wax	1.18				
	1.60				
	2.52	6.40	4.45	3.92	3.90
Untreated control		7.12	6.38	6.05	5.80

TABLE V

Effect of weathering and burial on treated fabrics exposed at various sites

Sample	% Compound	Breaking str loss on weathering (%) (a)	(b)	(c)	ΔF on weathering (rhes) (a)	(b)	(c)	Breaking strength loss on burial, 2 weeks (%) Not leached	Leached	Weathered (a)	(b)	(c)
Oxford cloth + water repellent	0.068	39	55	8	15.0	—	—	0	20	90	85	64
	0.192	45	63	3	15.4	16.6	1.0	0	5	90	83	8
	0.417	51	79	3	17.2	—	—	0	0	55	88	8
	none	32	33	5	12.9	11.9	3.1	97	96	91	78	100
12-oz duck + water repellent	0.157	37	51	0	8.4	—	—	0	16	73	76	32
	0.250	41	61	5	8.9	14.0	1.8	0	0	69	79	7
	0.482	44	67	0	8.9	—	—	0	0	47	72	0
	none	37	44	11	12.1	11.0	6.0	92	92	83	83	83

(a) 5 months, Ottawa 1953 (temperate)
(b) — 6 months, Kano, Nigeria 1954 (semidesert)
(c) — 6 months, Port Harcourt, Nigeria 1954 (jungle)

the compound applied from mixed solvents or solubilized, at a concentration of 1.0% gives complete protection. The earlier work had shown that when applied at the 0.5% level by the 2-bath method similar complete protection was obtained on unleached samples.

EFFECT OF EXPOSURE IN WEATHER-OMETER (HIGH U V INTENSITY ARC) ——— The data given in Table III show some evidence that the compound exerts a protective effect during the early stages of the exposure (4-day period). As exposure is continued to 20 days, the breaking strength losses increase sharply over those of the untreated control for the two higher levels of treatment and the increase in fluidity values are substantially greater than those of the untreated control for all periods of exposure and for all levels of compound.

In the waxed samples the breaking-strength loss and increase in fluidity were greater throughout than in the untreated control.

The pH of the water extracts of the exposed yarns (Table IV) showed a decrease with exposure time and, both initially and after exposure, the treated yarns were more acid than the untreated control. Initially, this does not appear to affect the breaking strength or fluidity. There is some evidence that the waxed samples develop slightly more acidity than the unwaxed samples. In general, the increase in the acidity of the treated samples appears to take place early in the exposure and to remain substantially constant from then on.

EFFECT OF EXPOSURE OUTDOORS AT VARIOUS SITES——— The data covering the exposure of the Oxford cloth and 12-oz dyed duck at the three sites are shown in Table V. It will be seen that, under jungle conditions, the compound exerts a protective effect against soil burial, even at levels as low as 0.2%. Apparently under these conditions the compound is not lost even though the samples were exposed to considerable rain. Apparently the limited exposure to sunlight is the factor here in preventing the destruction of the compound. A similar set of treated samples exposed in direct sunlight (semidesert conditions) showed similar effects to those obtained in the Weather-Ometer. The third set, exposed at Ottawa during the summer months, showed somewhat less damage than those exposed under semidesert conditions. These results are undoubtedly due to the fact that under conditions of moderate (Ottawa) to severe (semidesert) sunlight exposure, there is some actinic breakdown of the compound to give free hydrochloric acid which is partly responsible for the increase in damage shown over that of the control.

CHANGE OF COLOR———Since one of the advantages claimed for the compound is that it is colorless, it must be noted that, on exposure either to sunlight or in the Weather-Ometer, the treated samples turn to a pale reddish tan color in about 24 hours. This color eventually fades, this being complete in something over 2 months outdoors (due probably as much to loss of the compound as to bleaching) and, in the Weather-Ometer, begins to fade in 120 hours, this being complete in 192 hours, corresponding approximately to 4-5 weeks, and 2 months respectively, outdoor exposure. This color change may be objectionable for some uses.

DISCUSSION

The loss of compound on leaching seems to be dependent somewhat on the form in which the compound is applied to the fabric. Under identical conditions, the loss of compound in solubilized form applied from solvent is noticeably greater than with the nonsolubilized compound applied from mixed solvents. Moreover, contrary to the effect found with the latter, the inclusion of wax with the solubilized form increases, rather than reduces the loss of compound.

From the data of Table II, there is no definite evidence that, under conditions of moderate temperature, sunlight and rainfall, the compound accelerates actinic breakdown of the cotton substrate during weathering, even at the higher concentrations, where the residual content of compound is fairly high.

When treated samples are exposed to high-ultraviolet illumination, in the Weather-Ometer, in the absence of water so that no loss by water leaching is possible, there is positive evidence of enhanced degradation of the cotton. The markedly increased acidity of the yarns as compared with the untreated control, would seem to indicate that the change in pH was associated with the breakdown of the compound, with some liberation of hydrochloric acid occurring during the exposure.

An examination of the data in Table V shows that under jungle conditions (in the absence of sunlight) the compound has a protective effect on the fabric. Under these conditions of exposure the compound is not lost, since these samples buried for 2 weeks after exposure show a negligible loss of strength whereas the untreated control has no residual strength. A duplicate set of samples exposed in direct sunlight in semidesert show effects similar to those obtained in the Weather-Ometer. A third set of these samples exposed in Ottawa in the summer of 1953, show an intermediate effect, with the damaging effect of the compound not apparent.

In exposure tests carried out in the Panama Canal Zone, it was stated (*4*) that heavy duck exposed in the sun for 16 weeks showed a breaking

strength loss of 59%, as compared with 42% for the control, and sheeting 70% loss as compared with 21% for control. The pH value of the exposed treated sheeting was 4.4, as compared with 5.6 for the control.

The data obtained in this investigation suggest that the cause of the conflicting statements in the literature on the effect of the compound in enhancing tendering of cotton, on outdoor exposure, relates to the conditions of the exposure, especially with respect to the extent of sunlight and rain. Under hot dry conditions, marked tendering may occur. Where there is substantial wetting of the sample by rain, this effect is minimized and for exposures in the temperate zone may probably be disregarded.

CONCLUSIONS

As judged by the soil-burial procedure, 2,2′—dihydroxy 5,5′—dichlorodiphenyl methane is an effective fungicide for use with cotton, but its effectiveness is reduced somewhat by water leaching under neutral conditions.

It undergoes fairly rapid loss when applied to cotton duck, without a binder and subjected to outdoor weathering under conditions of moderate to high rainfall and sunlight. Under conditions of greater shade but high rainfall, the loss of compound is greatly reduced. This indicates that the high loss of compound in weathering is, at least in part, due to actinic degradation of the compound.

In the presence of a binder, eg, wax, the loss of compound on weathering is not greatly reduced.

There is no evidence that, under conditions of weathering involving moderate to high conditions of rainfall and sunlight, the compound enhances the chemical deterioration of cotton.

When cotton treated with the compound is exposed to conditions of moderate to high ultraviolet irradiation in the absence of wetting, there is some evidence of enhanced chemical breakdown of the cotton. This is believed to be due to the effect of small amounts of hydrochloric acid produced by the actinic breakdown of the compound. It is considered that under most conditions of outdoor weathering, excluding sunny dry conditions (in which the factor of microbiological deterioration is of minor importance) the compound, when used in amounts of 0.5-1.0%, should provide a level of protection against microbiological damage equal to other organic-type textile fungicides currently in use.

ACKNOWLEDGEMENTS

The authors wish to acknowledge with thanks the assistance given by F W Baker, meteorological observer, Central Experimental Farm, Department of Agriculture, Ottawa, in providing the weather data for the Ottawa exposures. Their thanks are also extended to the Ministry of Supply, Great Britain, for arranging the exposures in Nigeria; also to the Defence Research Board, Department of National Defence, Ottawa, for financial assistance in this work.

LITERATURE CITED

(1) Rose, G R F and Bayley, C H, *Am Dyestuff Reptr* **44**, 648 (Sept 12, 1955).

(2) "G-4 (Dichlorophene), An Annotated Bibliography," Sindar Corp, 330 West 42nd St, New York, NY.

(3) Abrams, E, National Bureau of Standards, Miscellaneous Publications No. 188 (Nov 1, 1948).

(4) Barghoorn, E S, "Studies on the Deterioration of Textiles Under Tropical Conditions in the Canal Zone", Office of Sci Res & Development (USA), Report No. 4807 (April, 1945).

(5) Barghoorn, E S, "Field Studies of the Deterioration of Textiles Under Tropical Conditions", Microbiological Series Report No. 4 (Textile Series Report No. 24), Office of the Quartermaster General (USA) (1946).

(6) Bayley, C H and Weatherburn, M W, *Can J Research* **F25**, 92-109 (1947).

(7) Block, S S, *Chem Inds* **62**, 226 (1948).

(8) Rose, G R F and Bayley, C H, *Textile Research J* **24**, 792 (1954).

(9) Gottlieb, S and Marshall, P B, *Ind Eng Chem* Anal Ed **18**, 16 (1946).

BOOK REVIEW

TEXTBOOK OF POLYMER CHEMISTRY

Fred C Billmeyer, Jr
E I du Pont de Nemours & Co, Inc
Interscience Publishers
New York, NY
$10.50; 526 pages
185 illustrations; 49 tables

This textbook, reportedly the first to provide complete coverage of the field of high polymers, has been written by Fred C Billmeyer, Jr, a research chemist for the Du Pont Company.

Dr Billmeyer, a member of the research staff in Du Pont's Polychemicals Department, has been engaged for a number of years in fundamental physical research on the molecular structure and optical properties of high polymers. He also teaches courses in high polymers at the University of Delaware.

His book deals with the physical chemistry as well as the organic chemistry of polymers. It covers the preparation and properties of plastics, fibers, and elastomers, and is up to date through the major advances of 1956.

Written specifically for first-year graduate courses, it may sometimes be suitable for senior undergraduates, and would aid many practicing chemists doing self-study or review work. —CAW

CORROSION: A COMPILATION

Mars G Fontana
Chairman, Dept of Metallurgical Engineering
Ohio State University
Hollenback Press
Columbus, Ohio

This book is a compilation of the monthly columns on corrosion written during the past ten years for *Industrial and Engineering Chemistry*. The articles are grouped into seven chapters 1) Nature and Extent, 2) Eight Forms of Corrosion, 3) Eight Methods for Combatting Corrosion, 4) Corrosion Testing and Evaluation, 5) Materials, 6) Environments, and 7) High-temperature Oxidation.

Practically all metals and alloys and some nonmetallics used for corrosion applications are covered. The book describes methods and detailed procedures for laboratory and plant testing, and shows corrosion as a function of temperature and concentration of acids through isocorrosion charts.

Causes and cures for many actual plant problems and mechanisms of corrosion are described in readily understandable terms.

The book is designed as an aid to plant men and as a reference text, or textbook, for courses in corrosion. It is used by the author as a text.—CAW

ATOMIC ENERGY AND THE TEXTILE RESEARCHER*

R G H SIU

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U S Army Quartermaster Corps
Washington 25, DC

I. THE CHANGING ROLE OF THE TEXTILE RESEARCHER

THE role of the researcher is changing. This has been particularly true in industrially oriented laboratories.

Decades ago the scientist was permitted to quietly pursue his own line of specialty. His professional mission in life was to plow within a narrow groove, formulate novel theories and conjure up new inventions in his solitude. With the growth of industrial recognition of research as a cornucopia of material wealth, a new class of scientist, and engineers emerged. Their function continued to be the use of specialized skills in the advancement of knowledge. But with this group, it was to be an instrument of company policy and interests.

At the same time, these researchers became technical consultants to industrialists on the implications of scientific advances with regard to the company's fortunes. We are beginning to see a diffusion of researchers into the policy councils and management of corporations.

As the competition within our free enterprise system increased its tempo, management became as much interested in the scientific progress being made by other than its own concerns and in fields of science and technology beyond those being supported within its own department. In his role as a scientific advisor, the researcher is being asked a new battery of questions—this time bearing on fields outside of his own specialty.

In the present instance, we can easily envision the management of a textile corporation asking his company's research laboratory, or an expert textile group, "I have been reading in the newspapers last week that so and so is discovering wonders in the field of atomic energy. What can we do to apply these findings toward the improvement of textiles and clothing? Is there anything in it for our own business? Should our company be in on it? In what way? And how do we go about it?"

I am not proposing that the textile technologist should forthwith become a nuclear physicist, a radiobiologist, a nuclear engineer or the like. On the contrary, as a textile technologist, his first aim should always be to be a *good* textile technologist.

However, because of his newly acquired position of a scientific confidante to management, he must broaden his scope of scientific and technological awareness.

The Walrus in "Alice-in-Wonderland" gave some pertinent advice in this regard.

"The time has come," the Walrus said,
"To talk of many things;
Of shoes-and ships- and sealing wax-
Of cabbages-and kings-
And why the sea is boiling hot-
And whether pigs have wings."

For a research man, that time has always come to talk of many things.

I should therefore like to ask your indulgence for departing from the usual topics for the B B Gossett lectures—namely, those directly related to contemporary textile laboratory problems. Instead, I should like to survey a field of tremendous scientific activity to stimulate the other side of your dual character, that of being technological advisors to management and scientific leaders in the community.

I shall briefly sketch the progress being made in the various applications of atomic energy, including illustrative examples of those questions which we anticipate may be asked of the textile technologist as a technical advisor.

II. RESEARCH TOWARD INCREASING ENERGY SUPPLY

There have been many calculations of the available sources of energy and how long the reserves will last.

The world reserve of oil has been estimated (*5*) at 1220 billion barrels. The production rate will reach a peak before the year 2000. After that it will begin to decline.

Within this country the estimates of coal reserves is 27 billion tons of present commercial grade, of natural gas 600 trillion cubic feet and of oil 87 billion barrels. The peak of our own production will reach a maximum within two decades.

The energy problem is even more acute in other nations, in which the available coal reserves is becoming rapidly inaccessible and the hydroelectric sources saturated.

With such a picture before us on so fundamental a matter, there is no wonder that there is considerable excitement and activity in developing nuclear sources of energy. Sir John Cockcroft of England predicted that by 1975 half of the electricity in his country will be generated from nuclear energy (*24*). Just several months ago, Queen Elizabeth turned on the Calder Hall Reactor, the first of a series of reactors which will feed nuclear electricity into the national grid of England.

The advances being made in the development of power reactors have been amazing. Our own Atomic Energy Commission has allotted $200,000,000 for the development of power reactors over a period of 5 years.

Confidence has reached such a point that design characteristics and principles for electricity from controlled *fusion* reaction in addition to the *fission* reaction exploited in present-day reactors are now being formulated.

Lapp's latest book (*36*) discusses the concept of feeding deuterium and tritium into an ionizer, which gives the gas particles a charge. The charged gases are then injected into a strong electromagnetic field. The electromagnetic impulses repeatdly cause the ions to bump into each other with increasing speeds until they fuse, thereby liberating energy. It has been estimated that a single thermonuclear reactor can produce several times as much electrical power as the entire United States now consumes.

The Atomic Energy Commission itself, with its Project Sherwood, has a very capable team on the subject and I am sure we can look forward

* Delivered as a B B Gossett Lecture at North Carolina State College, December 6, 1956.

to interesting results in the near future from the group.

In all of these nuclear power generators, the heat developed in the core of the reactor is converted into steam which drives a turbine, which in turn generates electricity. This is not an efficient process of conversion, so quite a bit of work is going on attempting to convert nuclear radiation directly into electricity. Over a dozen organizations in this country are working on the problem. The Radio Corporation of America is one of the leading laboratories. There are several approaches being pursued, although the semiconductor junction method seems to be attracting the greatest attention at the moment. This is the basis of the so-called atomic and solar batteries. At the present time, only very small amounts of power are feasible. But the ultimate payoff, if successful, is very large indeed.

III. RESEARCH TOWARD INCREASING WORLD FOOD SUPPLY

As you recall, Malthus in 1798 warned us about the possible outstripping of food supply by population growth (*40*). There has been a constant effort on the part of science and agriculture to keep this competition in balance.

Even as recently as 1952, The Food and Agricultural Organization of the United Nations estimated that 60 percent of the world's people receive less than 2200 calories per day. We need to remember that 3200 and 2300 calories are considered nutritionally adequate in this country for males and females, respectively. Based on an analysis of the situation, The Food and Agricultural Organization has recommended an increase in food production of 1 to 2 percent higher than the anticipated population growth (*59*). In some cases, this would mean an actual increase of 3 to 4 percent per year in agricultural yield.

For our own country the Paley Commission (*43*) estimated that, within the 25-year period ending 1975, we need a 40 percent increase in our farm output to satisfy our standard of living. This increase must be attained in the face of a declining farm population. Whereas 9 out of 10 Americans lived on farms at the beginning of our nation, today the ratio is less than 1 in 6 (*54*).

The researchers in food production and supply are continually under pressure therefore to devise means and techniques for augmenting the availability of foods. During the last decades they have applied atomic energy with notable rewards.

We read of the controversial claims of Russian workers, who recommend an exposure of seeds to nuclear radiations before sowing. In the case of sugar beets, for example, an increase in weight by 1.5 to 2 times and in sugar content by 0.7 to 3.0 percent was claimed (*63*). Zhezhel (*68*) cited results of a 9-year investigation involving potatoes, cabbage, clover and other crops in which he found an 8-year average increase of 32.9 percent. Kuzin (*35*) reported that radishes, if treated with 1000 r X-rays, ripened several days earlier. The tubers were bigger in size and better in taste and succulence.

American workers, such as Jones and Hoover (*31*), however, were not able to find comparable stimulation in crop yields by the use of radio-active substances. Report of the Atomic Energy Commission (*61*) stated that radium-, uranium- and actinium-containing fertilizers provided neither a positive nor a negative effect.

Through the use of nuclear radiations the development of new varieties of crops and animals can be speeded up. Some agricultural geneticists have estimated that the requisite time in one instance has been cut from 10 years to 18 months. Already in the relatively short period of our atomic age new strains of oats have been produced which are resistant to the stem rust disease. These were obtained from exposing seeds to slow neutrons (*32, 52*). New varieties of barley are already under actual field trial. These mature earlier than the others, which may significantly extend the area in which it can be grown in the future. Similar experience is being gained with corn, wheat and other crops. I have even been told that experiments are under way on the West Coast with the view of developing chickens with increased egg production.

Another demonstrated application of atomic energy is the control of the screw worm fly (*17*). This cattle pest costs the American farmer 20 to 25 million dollars annually in reduced income and treatment expense. Research by Bushland and Hopkins (*16*) showed that the male screw worm fly is sterilized by exposure to gamma rays from Cobalt-60 or X-rays. Its sexual virility, however, is not affected. Large batches of laboratory-reared males were irradiated and released in the field to compete for mates. Since the females mate only once, it was possible to reduce the population through sheer competition. In 1954 this technique resulted in the eradication of the pest from the island of Curacao in the Netherland Antilles. The investigators are now trying to see whether a similar success can be realized in the Southeastern areas of this country.

Radioisotopes are being employed with considerable success in elucidating the mechanism of living processes as a basis for improving agricultural production. There was the intriguing discovery (*34*) that the roots themselves are capable of absorbing carbon dioxide from the air and synthesizing it into sugars—something that we had thought all along was reserved to the green parts of the plant. Kuntz and Riker (*33*), using iodine-131 and rubidium-86 carbonate as tracers, were able to follow the movement of nutrients from one tree to another in a forest through the root grafts which were naturally produced underground.

During recent years there has been considerable attention directed toward the extension of atomic energy to food handling and distribution. One of the most fascinating research projects being vigorously pursued by the Army Quartermaster Corps in collaboration with other Government agencies, universities and industry is the preservation of foods by nuclear rays (*60, 62*). In this process raw foods are exposed to beta and gamma rays at varying dosages, depending upon the particular result desired. There is an increase in temperature of only a few degrees. The food itself therefore remains raw. At relatively low dosages the sprouting of potatoes and onions is inhibited. We can thereby stretch the distribution and marketing time over the year. At increased dosages, disease-causing worms, such as trichina, can be controlled. Those of us who are gourmets can now have rare porkchops without concern. Other gourmets can try raw fish without worrying about the flukes that might have been present. At still higher dosages insect life is inactivated. We can kill the insect eggs in stored grains and cereals; we can destroy the larvae in otherwise quarantined fruits. At the highest dosages all bacteria and fungi are killed. The raw food can then be handled and shipped to all parts of the world without refrigeration.

There are many problems still ahead of us, before we can realize these promising potentialities. One of the principal ones is a breakdown in flavor, color and texture in many foods by the rays. Nevertheless, the results so far are very encouraging. At this moment we, with the cooperation of the Atomic Energy Commission and the Army Corps of Engineers, are completing plans for a pilot plant in California. This will be the

world's first pilot plant devoted to the development of this peaceful use of atomic energy. It will have 3 main components:

a) A gamma-ray-producing reactor, probably a heterogeneous reactor of the MTR type but with an added indium sulfate loop. This will be the world's first reactor built for the production of gamma rays.

b) A linear accelerator for production of beta rays. This is unique in the quantity of electrons we expect to produce in the order of 20 kw.

c) A food processing plant.

IV. RESEARCH IN MEDICINE

There is a large amount of research being conducted on the application of nuclear energy to medicine. During the last decade over half a million patients in this country have been given radioisotopes in diagnostic procedures and over 50,000 for therapeutic purposes. Iodine-131 is now standard treatment for hyperthyroidism with a very high probability of cure (*64*). Phosphorus-32 is also very effective for polycythemia vera (*38, 46*).

To illustrate the ingenuity in the medical uses of radioisotopes, I would like to describe the detection and localization of brain tumors (*56*).

In the earlier techniques (*50*) phosphorous-32 was injected intravenously as the phosphate. The neoplastic tissues absorbed between 5 to 100 times as much of the radioisotope as the normal tissue. Since the isotope emits only beta rays, the detector must be very close to the tissue in order to detect the rather weakly penetrative radiation. A tiny detector in the tip of a probe 2 mm in diameter is now used routinely at operations (*48*). By noting the count rate at various depths and locations the resection plane can be determined.

With phosphorus-32, however, the surgeon cannot carry out a preoperative detection of brain tumors since the beta rays do not penetrate the skull. This led to the administration of gamma-ray-emitting isotopes, coupled with external measurements of radiation counts. Many techniques have been tried. Potassium-42 (*51*), radioiodine labelled diiodofluorescein (*10*) and serum albumin (*23*) have been used with varying degrees of promise.

The use of positron-emitting isotopes has been found recently to have good possibilities (*67*). A positron resembles an electron, except it has a positive charge. When the positron reaches a certain thermal energy, however, it combines with an electron and disappears. In this process of annihilation, 2 X-ray quanta of 0.51 mev are emitted in opposite directions. With detectors at opposite sides of the head, the surgeon can detect the position of the tumor rather accurately. Several isotopes have been tried, such as manganese-52 and copper-64. The one being studied most intensely is arsenic-74 which concentrates in tumor tissues up to 15 times higher than in normal tissues (*57*).

V. RESEARCH IN TRANSPORTATION

You are all familiar, of course, with the first large-scale application of nuclear energy to transportation. The keel of the Nautilus was laid in 1952. Since then it has cruised over 50,000 miles on the original fueling. The current cost of atomic power plants of this type is much higher than conventional types. Admiral Rickover estimated (*47*) a replacement cost of the Nautilus power plant to be $18,000,000 as compared to $2,500,000 for an oil-fired plant of equivalent horsepower. Considering the experience gained since then, McMullen estimated (*42*) that for a 20,000 shaft horsepower tanker propelled by nuclear engine, we may be able to get by with $850 per shaft hp, as compared to conventional types of $450 per shaft hp. The advantages are so intriguing, however, that we are witnessing an upsurge of interest. Even atomic planes are being pushed, and on October 15th the president gave final approval for the construction of the first atomic-powered merchant ship, designed for 20,000 hp, 100 passengers and 12,000 tons of cargo at 21 knots, costing $42.5 million.

VI. RESEARCH IN INDUSTRIAL RADIOISOTOPE APPLICATIONS

A widespread application of atomic energy in industry is the use of radioisotopes as gauges, for radiographic testing and as tracers (*1*). In 1954, Joseph Campbell, former commissioner of the Atomic Energy Commission, estimated that radioisotopes provided an annual savings of $100,000,000 to American industry.

Perhaps the widest use of radioactivity in American industry today is gauges. The basic principle is simple. Essentially a radioisotope with known radiation is placed on one side of the material to be measured and a calibrated detector on the other. Continuous measurements of mass per unit area can be made without contact with the material. The resulting data can then be fed back into the system to control the process.

Wiggin (*66*), of the Atomic Industrial Forum, Inc, reported that a manufacturer of coated abrasives found that the installation of 5 radioactive thickness gauges on his production line paid for themselves in less than a year through a reduction in rejections, waste, machine down-time and inspection personnel and an increase in operating speeds.

In this profitable use of radioactive gauges it is not necessary that the material involved be expensive. Paper mills, for example, found considerable value in cutting down the weight fluctuations from 2 to 4 times. A fiberboard milk carton manufacturer saw his chief savings in decreasing jams in the bending machines due to a better fiberboard quality resulting from closer tolerance control by radioactive gauges.

The sugar-cane refineries in Hawaii are using cesium-137 gauges for the continuous control of streams of bagasse and sugar for milling and production, as well as the determination of integrated weights for any period of time (*13, 14*). The error in estimating mill loads is ± 5 percent and in weighing raw sugar ± 1 percent.

Another adoptation of radioactive gauges is the liquid-level rejection of unfilled containers.

Reflection type gauges have also been developed. In this case, the backward and scattered radiations are measured. The radioactive source and detector are mounted side by side, so that both sides of the material to be inspected need not be exposed. With beta-ray sources, one can determine the thicknesses of films and platings. With gamma-scattering gauges, corrosion in pipes can be detected. A periodic shutdown of the plant for pipe inspection is no longer necessary. No detailed proven figures are available as to the practical significance of this technique, but Seligman (*49*) estimates an increased production of several percent in some plants.

You are familiar with the use of radioisotopes in radiographic inspection. So I will pass over it quickly, citing just one example. The Ford Motor Company uses the technique for wing sections, stabilizer castings. Wiggin (*66*) estimated that, for many purposes of this kind, cobalt-60 appears to be 2 to 20 times cheaper than X-ray machines.

The use of radioactive tracers is also well known. This subject, too, I will cover with just one illustration. Workers at B F Goodrich Company (*39*) incorporated radio active phosphorus

in the triphenylphosphate plasticizer in tires. By measuring the radioactivity adhering to the road surface, they showed that the life expectancy of a tire at 67 mph is only 57 percent that at 30 mph.

Radioactive monitoring in the search for oil wells is even more striking. About 85 percent of the wells drilled turn out dry. Since they cost about $100,000 apiece, we can understand how desirable more accurate means of exploration would be. In studying the problem in Canada, T Lundberg found that there is a halo of gamma emission around a subterannean pool of oil. There seems to be less gamma radiation from the ground above the pool of oil and a little more around the edges. By flying sensitive counters over an area suspected to have oil, a grid can be plotted and the probable centers of the oil domes below determined in a few days. The old method of hit and miss drilling may take years.

VII. RESEARCH RELATED TO TEXTILES

Research in the field of atomic energy pertaining to textiles has not been as broad in coverage as in other fields. Within one narrow segment of textile interest, however, much has been done. This is the effect of nuclear rays on high polymers.

The direct reactions occurring when an organic macromolecule is irradiated can be of several kinds. Because of the so-called "cage effect" it is not likely that the macromolecule will dissociate into two large radicals. If it should happen, the radicals will immediately recombine. It is probable that the following 2 kinds of reactions occur:

a) The loss of a hydrogen atom or a methyl radical, which can diffuse out of the cage. This leaves a radical macromolecule which is free to combine with others.

b) The cleavage into 2 stable molecules which cannot recombine (*2*).

Ever since the first detailed paper in 1948 by Davidson and Geib (*27*) on the action of radiations from a nuclear reactor on certain rubbers and technical mixtures, an appreciable number of publications began to appear on polymers. Charlesby's group in England is among the most prolific (*19*); there are also the General Electric Group in this country (*37*) and Chapiro and associates at The University of Paris (*18*).

The work has been spurred on by the needs of the reactor engineers, who must know how structural materials are affected by nuclear rays. Among the materials studied are various plastics and elastomers (*25, 53*). With polystyrene, there is a drop in elongation and impact strength upon bombardment with neutrons. At 10^8 rads there is a 75 percent drop in elongation and 50 percent in impact strength, and an increase in tensile strength and elastic modulus. At 10^9 rads there is a 20 percent increase in tensile strength with the curve ascending rapidly thereafter and a 15 percent increase in elastic modulus but no significant change in sheer strength.

For casein (Ameroid) there is a drop in tensile strength, elongation, sheer strength and impact through beginning at 10^7 rads of thermal neutrons, but there is no effect on the elastic modulus, weight and Rockwell hardness.

With cellulose propionate (Forticel), there is a drop in tensile strength, elongation, sheer strength, impact strength beginning at 10^6 rads of thermal neutrons.

With polyamide (Nylon FM100001, FM-1) there is a rapid drop in elongation and impact strength, but an increase in elastic modulus with some increase in tensile strength.

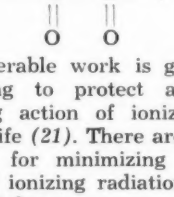
Recent work at the Wright Air Development Center and at the Goodyear Company indicated that rubber can be vulcanized by radiation.

The melting point of waxes was increased. But since dosages in the order of 100 megarep was required, workers at Brookhaven did not feel it worth their while to continue this line of investigation. They have also been trying to improve the printability of polyethylene films. Although current methods, such as oxidizing baths with saturated chromic and permanganic acids, chlorination, or ultraviolet exposure, appear to improve the printability and adhesive properties toward other laminating materials, such as Kraft paper, blotting paper, zinc, copper, aluminum foil and glass, at least several fold, the bugaboo of decreasing heat sealability remained. So far this problem has not been solved. At radition doses over 1000 megarads, polyethylene begins to acquire some of the mechanical properties of glass (*22*).

Commercially irradiated polyethylene products are now on the market. General Electric produces Irrathene, which is an irradiated polyethylene tape used as insulation by motor repair shops. This product offers high temperature stability plus the excellent electrical and mechanical properties of conventional polyethylene. Another product is sold by the Sequoia Process Corporation of Redwood City and Kansas City. Electrons are used to bombard plastics to form a tough new form of polyethylene wire coating, known under the trade name Hyrad.

One of the earliest reports of the effects of ionizing radiations on proteins, of course, was that made by Astbury and Woods in 1933 (*4*). Using X-rays on dry proteins, they found that the physical properties of wool fibers were greatly modified. There was an increase in supercontraction and a decreased tendency to acquire a permanent set. Such changes can be brought about either by breaking the peptide bonds in the main chains or by severing the disulfide bonds which link the chains (*3*) or salt linkages (*30*).

The effect of ionizing radiations on the sulfur linkages in proteins has been the focus of much fundamental biochemical work, especially by Barron in Chicago and Dale's group in England (*6*). These workers have been concerned with the inactivation of sulfur-containing enzymes. They have been particularly interested in those enzymes containing cysteine and glutathione. Barron (*8*) observed, for example, that the only reaction which occurs is the oxidation of the sulfhydryl to a disulfide bond. He noted an ionic yield of one in the absence of oxygen and four in its presence, which was in perfect agreement with theory. Dale and his associate (*26*), however, felt that the reaction is not this simple. H_2S is formed, as well as sulfoxides



Considerable work is going on in attempting to protect against the damaging action of ionizing radiations to life (*21*). There are three approaches for minimizing the direct action of ionizing radiations.

A) Substances may be added which influence the conversion of the absorbed energy, so that less reaction occurs with the vital molecules. Almost 2 decades ago, Svedberg and Brohult (*55*) found that the passage of an alpha particle anywhere through the giant haemocyanin molecule can bring about its splitting into 2 equal parts. This simply indicates that the energy absorbed in one part of the molecule can be transferred to the bond holding the 2 halves together. Not only is this true within the same molecule but other workers have found that the absorbed energy can be transferred from one molecule to another when a mixture of 2 liquids, such as benzene and cyclo-

hexene, is irradiated *(15, 41, 44)*. The transfer of charge by collision between an ionized and an unionized molecule plays an important part. How significant this energy transfer is in solid systems remains to be shown.

B) The damage can be repaired if the right substance is present just at the moment between the primary reaction induced by the ionizing radiation and the onset of the irreversible reaction. This cannot be done in such reactions as the decarboxylation of pure stearic acid by alpha rays *(11)*. In other cases, involving the loss of a hydrogen atom leaving an organic radical, such as when solutions of polyvinyl alcohol are irradiated *(12)*, the damage can be reversed. In the absence of added substances these organic radicals cross-link to give a stiff gel. In the presence of substances such as sulfhydryl containing compounds, the activated molecule is prevented from cross linking.

C) We may also protect the vulnerable group in a molecule, such as the prosthetic group of an enzyme, by the addition of a protectant *(28)*. In the case of polymethylmethacrylate, a cleavage in the main chain occurs for each 61 ev of gamma ray energy absorbed. In the presence of 10 percent allylthiourea, the figure is raised to 143 ev *(20)*.

The results uncovered by these workers may provide us in the textile field with valuable suggestions as to how we can go about channeling our reactions on the textile fibers being irradiated. We know, for example, that reaction at the disulfide bond in wool plays an important role in the chlorination process *(29, 45)*.

One of the most interesting catalyses by ionizing radiations is that of "graft copolymerization" *(9)*. If a mixture of polymer A_n and a monomer B_m is irradiated, a polymerization of the resulting macroradicals with the monomer occurs to give a grafted copolymer A_nB_m. By adjusting the relative amounts of the two components, grafted copolymers of varying properties can be obtained. This technique can be carried on with more or less finished objects. Even cellulosic fibers can be graft-polymerized. I understand that French chemists have been able to effect a 20 percent pick up of acrylate resins by this technique and have also had some success with Teflon.

VIII. CONCLUSION

We can see from this brief survey that atomic energy is permeating the entire fabric of our twentieth century technological society. Impressive and spectacular advances are being made. However, we note that out of the thousands of discussions and articles on the peaceful uses of atomic energy at the United Nations International meeting at Geneva in September 1955, very few pertained directly to textile research. The 1955 proceedings of the McKinney Panel on the Peaceful uses of Atomic Energy of the Congressional Joint Committee on Atomic Energy made practically no reference at all to textile laboratories.

It is true that textile technologists are beginning to explore the possibilities of atomic energy. Some have already contributed significantly. For example, there is the work of Teszler and Rutherford on the effect of nuclear radiation on fibrous material *(58)*. There is the report by White and associates on the use of radioactive tracers for studying adsorption from solution *(7, 65)*. There are our own Quartermaster laboratories with Degering, Hasselstrom, Bailey and Laconte, who have been studying polymerization reactions, the development of more rapid weathering tests by correlation with nuclear radiation changes and new organic syntheses. By and large however, it appears that the pick-up has been not as rapid in the textile field as in others.

With the exciting and spirited research on atomic energy going on all around us, our alert textile executives and friends cannot help but wonder whether some of the findings, techniques, viewpoints and promises that are blazing new paths in many fields of human endeavors can also find fruitful outlets in the textile areas.

Can the properties of textile fibers be improved by the use of nuclear radiations? Can radioisotope meters be adapted to plant control of fiber blending processes? Can colorless radioactive tagging find a place in the tinting of raw stock for blending? Can the current principle of dyeing based on adsorption be augmented with one based on free radicals induced by ionizing radiations? Would this open up a new class of coloring substances for our synthetics? How useful will radiochemical grafting be to the development of new types of textile finishes? What new potentialities are opened by such radiochemical processing in the case of nonwoven fabrics? Can control of insects and microorganisms by nuclear rays be of any value for textiles? Where in our production plants can we use radioactive thickness gages—corrosion detectors—static electricity bleeders? What are the possibilities of coupling power production with gamma-ray production for use in textile industries?

To whom then will the textile executive turn to seek guidance and answers to such questions? I believe the first person would be his scientific and technological consultant—the textile researcher. To retain the deep confidence of his patron, the textile researcher must find the answers for him. He must carry out research on his own in the application of nuclear science. He must know the specialists outside of the textile laboratory, who can solve ancillary problems. Above all, he must have a sense and intimate feeling of the trends of nuclear research in this atomic age.

REFERENCES

(1) Aebersold, P C, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **14**, 3 (1955).
(2) Alexander, P, Charlesby, A and Ross, J, *Proc Roy Soc* **A223**, 392 (1954).
(3) Alexander, P and Hudson, R F, "Wool, Its Chemistry and Physics," Chapman and Hall (1954).
(4) Astbury W T and Woods, H J, *Phil Trans* **A232**, 333 (1933).
(5) Ayers, E, *Sci Amer* **195(4)**, 43 (1956).
(6) Bacq, Z M and Alexander, P, "Fundamentals of Radiobiology," Academic Press (1955).
(7) Barnard, W S, Palm, A, Stam, P B, Underwood, D L and White, H J, *Textile Research J* **24**, 863 (1954).
(8) Barron, E S G, In Nickson, J J, "Symposium on Radiobiology," Wiley (1950).
(9) Bouby, L, Shapiro, A, Magat, M, Migirdicyan, E, Prevot-Bernas A, Reinisch, L and Sebban, J, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva*, I, 526 (1955).
(10) Boyak, I G, Moore, G E and Clausen, D F, *Nucleonics* **3(4)**, 62 (1948).
(11) Breger, I A, *J Phys Chem* **52**, 551 (1948).
(12) British Empire Cancer Comp. Report No. 31, 13 (1954).
(13) Burr, G O and Payne, J H, *Hawaiian Sugar Technologists* 124 (1954).
(14) Burr, G O, Tanimoto, T, Hartt, C E, Forbes, A, Sadaoka, G, Ashton, F M, Payne, J H, Silva, J A, and Sloane, G E, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **12**, 177 (1955).
(15) Burton, M and Patrick, W N, *J Phys Chem* **58**, 421 (1954).
(16) Bushland, R C and Hopkins, D E *J Econ Entomol* **44**, 725 (1953).
(17) Bushland, R C, Knipling, E F and Lindquist, A W, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **12**, 216 (1953).
(18) Chapiro, A, *J Chem Phys* **52**, 246 (1955).
(19) Charlesby, A, *Proc Roy Soc* **A215**, 187; **A217**, 122; **A218**, 245; *Nature* **171**, 1153 (1952-3).
(20) Charlesby, A, *Nature* **171**, 167 (1953).
(21) Charlesby, A, In Bacq, Z M and Alexander, P, "Radiobiology Symposium," Liege, Academic Press (1954).
(22) Charlesby, A, *Nucleonics* **14(9)**, 82 (1956).
(23) Chou, S N, Aust, J B, Moore, G E and Peyton, W T, *Proc Soc Exp Biol Med* **77**, 183 (1951).
(24) Cockcroft, J, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **1**, 409 (1955).
(25) Collins, C G and Calkins, V P, Report APEX 261, U S Air Force Contract AF33-(038)21102, September (1956).
(26) Dale, W M, *Biochem J* **48**, 129 (1951).
(27) Davidson, W L and Geib, I G, *Appl Phys* **19**, 427 (1948).
(28) Doherty, G D, *Federation Proc* **11(1)**, 35 (1952).
(29) Elliott, G H and Speakman, J B, *J Chem Soc* 641 (1940).
(30) Harris, M, Mizell, L R and Fourt, L, *Am Dyestuff Reptr* **31**, 376; *Ind Eng Chem* **34**, 833 (1942).
(31) Jones, U S and Hoover, C D *Am Fertilizer* **110**, 12 (1949).
(32) Konzok, C F, *Agron J* **46**, 538 (1954).
(33) Kuntz, J E and Riker, A J, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **12**, 144 (1955).
(34) Kurzanov, A L *ibid* **12**, 3 (1955).
(35) Kuzin, A M, *ibid* **12**, 149 (1955).
(36) Lapp, R, *"Atoms and People,"* Harper (1956).
(37) Lawton, E J, Bueche, A M and Balwit, J S, *Nature* **172**, 76 (1953).

(38) Lawrence, J H, Scott, K G and Tuttle, L W, *Intern Clin* **3**, 33 (1939).
(39) Loughborough, D L and Born, J. Cited in Eaton, S E, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **14**, 61 (1955).
(40) Malthus, T R, 1798. An Essay on the Principle of Population. Reprinted for the Royal Economic Society 1926.
(41) Manion, J P and Burton, M, *J Phys Chem* **56**, 560 (1952).
(42) McMul'en, J J. In Report of Panel on Impact of Peaceful Uses of Atomic Energy to Joint Committee on Atomic Energy, U S Congress, Washington, D C, 2, 224 (1956).
(43) Paley, W S, Brown, G R, Bunker, A H, Hodgins, E, and Mason, E. S. Report by The President's Material Policy Commission, Washington, D C (1952).
(44) Patrick, W N and Burton, M, *J Phys Chem* **58**, 424 (1954).
(45) Phillips, H, *J Textile Inst* **37**, 302 (1946).
(46) Reinhard, E H, Moore, C V, Bierbaum, V S and Moore, S, *J Lab Clin Med* **31**, 107 (1946).
(47) Rickover, H G. In Report of Panel on Impact of Peaceful Uses of Atomic Energy to Joint Committee on Atomic Energy, U S Congress, Washington, D C, 2, 270 (1956).
(48) Robinson, C V, *Rev Sci Instr* **21**, 82 (1950).
(49) Seligman, H, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **14**, 13 (1955).
(50) Selverstone, B, Solomon, A K and Sweet, W H, *J Am Med Assoc* **140**, 277 (1949).
(51) Selverstone, B, Sweet, W H and Ireton, R J. In Surgical Forum, Amer Coll Surg, W B Saunders (1950).
(52) Singleton, W R, Konzak, C F, Shapiro, A and Sparrow, A H, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **12**, 25 (1955).
(53) Sisman, O and Bopp, C D, Report ORNL 928, Tech Inf Service, U S Atomic Energy Commission, Oak Ridge, Tenn (1951).
(54) Stefferud, A, "Marketing, The Yearbook of Agriculture," U S Government Printing Office (1955).
(55) Svedberg, T and Brohult, S, *Nature* **143**, 938 (1939).
(56) Sweet, W H and Brownell, G L. In Radioisotopes in Medicine, Oak Ridge, Institute of Nuclear Studies (September, 1953).
(57) Sweet, W H and Brownell, G L, *J Am Med Assoc* **157**, 1183 (1955).
(58) Teszler, O and Rutherford, H A, *Textile Research J* **26**, 796 (1956).
(59) United Nations FAO, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **12**, 10 (1955).
(60) United States Army Quartermaster Corps, Monograph on Radiation Preservation of Food.
(61) United States Atomic Energy Commission. Quoted in *Chem Eng News* **30**, 8, 750 (1952).
(62) United States Congress. Hearings before the Subcommittee on Research and Development, Joint Committee on Atomic Energy, Washington, D C (June 8, 1956).
(63) Vlasyuk, P A, Conf Acad Sci USSR (July 1-5, 1955).
(64) Werner, S C, *Med Clinics of No Amer* **36**, 623 (1952).
(65) White, H J, *Proc Intern Conf on Peaceful Uses of Atomic Energy, Geneva* **15**, 39 (1955).
(66) Wiggin, E A. In Report of Panel on Impact of Peaceful Uses of Atomic Energy to Joint Committee on Atomic Energy, U S Congress, Washington, D C, 2, 263 (1956).
(67) Wrenn, Jr, E. R. Good, M L and Hendler, P, *Science* **113**, 525 (1951).
(68) Zhezel, N G, Conf Acad Sci USSR, July 1-5, 1955.

Abstracts

Humidity in Textile Processing

Porter, R, *Textile Recorder* **74**, 50-1, January, 1957

The moisture regain of man-made fibers under standard test conditions of 70°F and 65% rh is 0.5% for Terylene, about 4% for nylon, and approximately 11% for viscose, and a critical control of humidity is necessary during processing, especially when blends of these fibers are being run.

Generally speaking, as relative humidity, and hence the regain, of regenerated cellulose and protein-based fibers increases, the tensile breaking load decreases and extensibility increases; eg, a 100-denier viscose filament yarn under a tension of 75 grams would extend by 1% at 40% rh. At 80% rh the same extension would be achieved with a tension of only 35 grams. At high rh the elastic limits of these fibers are reached much more rapidly and at lower tensions. It is therefore essential to control humidity closely when these yarns are being wound under tension on to packages which do not allow for recovery.

The load extension properties of noncellulosic fibers, like nylon, Terylene and Orlon, are not so sensitive to humidity changes. With nylon and Terylene staples, however, humidities of the order of 90% are required for reasonable processing. Such high humidities are obviously unsuitable and impractical both for personnel and machinery, and the use of antistatic dressings and/or electrostatic eliminators is essential if processing under reasonable atmospheric conditions is to be possible. Orlon behaves differently and can be processed satisfactorily at rh as low as 30 to 50%.

The electrical resistance of all textile fibers is extremely sensitive to changes in their moisture content, and hence also to changes in the rh of the atmosphere in which they are processed or stored. The conductivity of fibers increases with moisture content, and therefore if the rh of the atmosphere can be increased to render the fibers sufficiently conductive, the dissipation of any static generated will be rapid enough to prevent it from building up sufficiently to cause difficulty in processing.

The accumulation of static can be prevented in two ways:

Antistatic agents, applied to the textile, form a conducting film on the surface of the fibers or yarn, and thus permit static charges to be dissipated. In the worsted industry particularly, antistatic agents have been used increasingly during the last few years.

Static eliminators may be either electrical or radio-active. The Shirley Static Eliminator uses electrodes which produce a belt of ionized air; the textile is passed through this belt, and any static is discharged at once. Radio-active static eliminators emit radiation and render the air conductive. This type works more slowly, and is said to be used mostly to prevent "fog-marking."

Ten references to the literature are cited.—WHC

Metallic Yarns in Processing

Anon, *Man-made Textiles* **33**, 70-1, March, 1957

Metallic yarns are now accepted as an important and vital addition to the range of materials and products which are available to the textile industry. The use of Lurex in particular is rapidly extending to almost every type of fabric.

Lurex is most commonly supplied to the trade as a continuous flat ribbon of yarn on spools, cones and tubes. The three standard types are as follows:

Butyrate Lurex, aluminum foil base, bonded between two layers of clear cellulose acetate butyrate film. Lurex in this form is the original nontarnishing metallic yarn used for general purposes.

Lurex MM, metallized Mylar base bonded between two layers of clear Mylar film, or one layer of metallized Mylar bonded to one layer of clear Mylar. The metallized Mylar, produced by vacuum deposition of aluminum on Mylar film, lends particular softness, strength with light weight, thinness and brightness to the yarn. Mylar is the film equivalent of Dacron, or Terylene, polyester yarn.

Lurex MF, two layers of clear Mylar with a layer of aluminum foil bonded between. This yarn is particularly well suited to textile wet processing.

In general it may be stated that all these yarns will withstand the majority of wet processing conditions, but it is necessary to control temperatures according to the nature of the yarn involved. For butyrate Lurex the limiting conditions are those applicable to cellulose acetate, which implies a ceiling temperature of 180°F.

Fabrics containing these metallic yarns may be bleached successfully with chlorine, peroxide or sodium chlorite. For dyeing, usually the metallic yarn is to be left white. If colored effects are desired, the butyrate Lurex may be dyed successfully with disperse dyes, and Lurex MM and MF with selected disperse dyes with or without a carrier.

The author gives full details for handling fabrics containing these yarns through the various wet-processing operations. He also includes methods for identifying the three types of yarn.—WHC

Proceedings of the
American Association of Textile Chemists and Colorists

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June 3, 1957

AATCC Research———

DETERMINATION OF HYDROGEN PEROXIDE IN BLEACH BATHS

Committee on Bleaching

PURPOSE AND SCOPE——This method provides the means determining the percentage of hydrogen peroxide (as 100% H_2O_2) in bleach baths.

PRINCIPLE———An aliquot of the bleach bath is titrated with 0.588 N $KMnO_4$. The number of ml of $KMnO_4$ required with the decimal point moved one place to the left will be the same figure as the % strength of the bath expressed in terms of 100% H_2O_2.

APPARATUS AND MATERIALS

Balance, analytical
Balance, platform
Beakers, 2-l and 500-ml
Burette, 50-ml
Cylinder, graduated, 25-ml
Flasks, Erlenmeyer, 250-ml
Flask, volumetric, 1-l
Pipette, 100-ml
Potassium permanganate solution, 0.588N
Sodium oxalate, cp
Water, distilled
Sulfuric acid, conc

PROCEDURE —— To approximately 20 ml of distilled water add 10 ml of the bleach bath and 20 ml of dil sulfuric acid (1 part conc H_2SO_4 to 4 parts H_2O). Titrate with 0.588 N $KMnO_4$ solution to the end point, which is the point where one drop of the standard will impart to the solution a faint pink color lasting for 30 sec. Read the number of ml of the $KMnO_4$ solution used.

CALCULATIONS———Moving the decimal point of the titer one place to the left will give the same figure as the percentage of 100% H_2O_2 in the solution. To convert to 50% peroxide, multiply by 2 and to 35% peroxide, multiply by 3. (2.86 is the actual figure but 3 is close enough for all practical purposes.)

MODIFICATIONS———Where the titer is too small, dilute the permanganate solution 10 to 1 with distilled water. Carry out the titration as given above. Moving the decimal point two places to the left will give the same figure as the % of 100% H_2O_2 in the solution.

PRECAUTIONS —— Solutions containing oxidizable organic materials may interfere with this method of analysis. However, for the analysis of bleach baths this is not an important factor.

PREPARATION OF 0.588 N $KMnO_4$————Weight about 52 g of $KMnO_4$ into a beaker and dissolve in about a liter of hot water. Let the solution stand for at least ½ hour and then decant ¾ of the volume and dilute to approximately two liters.

STANDARDIZATION OF $KMnO_4$ ———Weigh accurately 6.7000 g of pure, freshly dried sodium oxalate. Dissolve in 250-300 ml of hot distilled water. Cool, transfer to a liter volumetric flask and make up to the mark with distilled water. This solution will be exactly N/10.

Pipet 100 ml of the above solution into an Erlenmeyer flask. Add 10 ml of conc H_2SO_4 and heat to boiling. Titrate immediately with the $KMnO_4$ solution, adding to latter drop by drop at first. The first appearance of a faint but permanent pink is taken as the end point. Calculate the normality and adjust as necessary.

1 ml 0.588 N $KMnO_4$ = 0.3940 g $Na_2C_2O_4$

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*Cooperating nonmember

An AATCC-approved method for the determination of hydrogen peroxide is presented.

Because a variety of methods for testing peroxide in bleach baths are being used, it was deemed desirable and necessary to standardize on one method particularly due to the increasing number of new peroxide manufacturers entering the field.

After considerable study by the Committee on Bleaching the method developed was submitted to the Committee on Analytical Methods and was modified according to their suggestions.

Several peroxide manufacturers have already agreed to adopt this new procedure and modify their literature and technical bulletins accordingly.

Uniformity throughout the trade as far as this test is concerned will be of great benefit to bleacheries since titrations of peroxide are usually run by nonscientific personnel.

PAPERS FOR 1957 CONVENTION

INDIVIDUALS and firms desiring to present papers at the AATCC Convention in Boston, Nov 14-16, 1957 should send 100-200 word summaries to;

J Edward Lynn
19 Lockwood Drive
Old Greenwich, Conn,

before June 15, 1957.

Papers should be of interest to a large segment of the textile industry. Oral presentation should be streamlined to a 20-minute delivery time.

Only one technical paper will be presented at a time—there will not be simultaneous sessions—giving each paper the maximum audience possible.

Papers are requested covering the dyeing and finishing of fiber and fabric blends, automation, and instrumentation, especially the use of electronics and radioactivity.

NOTE

Your attention is called to the article "Random Tumble Pilling Tester" by E M Baird, L C Legere and H E Stanley, which appeared on pages P365-8 of the May 20th issue of the *Proceedings*.

In the course of the presentation of this paper before the New York Section on October 19, 1956, Dr A G Scroggie pointed out that recent work had demonstrated that 25 milligrams of 0.2-inch long cotton fiber, rather than the 50 milligrams originally recommended, gave more realistic pills. It had also been found desirable to dye the cotton a light gray color in order to simulate the rather dirty appearance of cotton lint encountered in pills formed on garments during wear.

He announced that commercial models of the Random Tumble pilling tester would be made available shortly through Atlas Electric Devices Co, Chicago, Ill.

An error in printing appears in the second sentence of the caption under Figure 3. It should correctly read "Coefficient of correlation, $r = 0.96$ (significant for 99% probability)."

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APPLICATION FOR TRANSFER TO SENIOR MEMBERSHIP

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James E Flegal
Charles J Graham
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Gordon O Smith
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Frank Wolski

Piedmont Section———

APPLICATIONS OF RADIOACTIVITY IN THE TEXTILE INDUSTRY*

IRVING A BERSTEIN

Head, Chemistry Dept
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This paper presents a summary of past applications of radioactivity to problems in the textile industry and suggests areas of work for future investigations that are particularly promising. Applications of radioactivity both in laboratory investigations and in plant process control are discussed. A brief description of the basic nature and properties of radioactive materials is presented. A bibliography is included which lists reference books on fundamental principles of radioactivity and its measurement (1,2,3,4) and previous review articles on use of radioisotopes in the textile industry (5,6,7,8,9).

NATURE OF RADIOACTIVITY

RADIOACTIVE materials have been known to occur in nature for some sixty years, but by far the most important applications of radioactivity have been made within the last ten years when radioisotopes produced in nuclear reactors and accelerating machines became widely available. Radioisotopes of a large number of elements are now readily obtainable at moderate cost.

Nuclei of radioactive isotopes are unstable due to excessive amounts of energy and tend to reach more stable states by emitting radiations. The rate at which different radioactive materials give off these energies and become stable ranges from seconds and minutes up to billions of years. The term that is used to indicate how long the radioactivity remains before decaying away is called the "half-life", and this is the length of time in which the radioactivity present will decay to half its initial value.

Three types of nuclear radiations may be emitted in radioactive decay:

1) *Alpha particles,* which are helium nuclei, are weakly penetrating and emanate from the heavy elements. This type of radiation is, in general, of little interest in industrial applications.

2) *Beta particles,* which are high-energy electrons, penetrate to a limited extent.

3) *Gamma rays,* which are high-energy rays similar in properties to energetic x-ray radiation, are extremely penetrating and some tracer applications make use of this property.

The detection and measurement of nuclear radiations are made using specialized equipment and instrumentation that is now widely available. Only brief reference will be made here to types of equipment used for the basic detection of radiation.

There are three important methods of radiation detection:

1) The method that is most commonly used is a gas-filled detector, such as a geiger tube, an ionization chamber, and a flow counter. These three detectors operate on the same basic principle. In general, they are all cylindrical in shape and contain a center-wire anode with a large voltage difference placed across the wire and the sides of the tube. When nuclear radiation penetrates into the counter, it causes ionization in the gas resulting in the formation of electrons. In "ionization chambers" the electrons are collected at the anode and measured as a current. In "geiger tubes" and "flow counters" where a larger potential difference is placed across the counter, electrons are accelerated to the anode, interacting with the fill gas causing further ionization. Finally an "avalanche" of elec-

TABLE I
Principle types of radiation emitted by radioisotopes

Type	Symbol	Description	Rest mass (0=16)	Charge (Electron=1)	Range in air	Ion pairs per cm in air
Alpha particles	α	Nuclei of helium atoms	4	+2	2 to 9 cm for 3 to 10 mev	30,000 to 70,000 (varies with distance from source)
Beta particles	β	Electron ejected from a nucleus	$\frac{1}{1840}$	−1	160 to 2,000 cm for .5 to 5 mev	150 to 40 for 0.1 to 5 mev
Gamma rays	γ	Electromagnetic radiation produced only in nuclear processes	None	None	15,000 cm ½ value thickness for 1.5 mev	1/100 of no. of pairs produced by same energy β

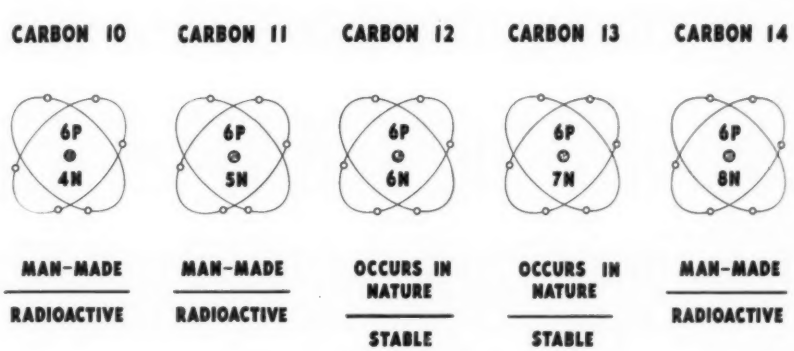

Figure 1
What are isotopes?
Isotopes are atoms of an element distinguishable by their weight.

* Presented before the Piedmont Section March 30, 1957 at the Hotel Roanoke, Roanoke, Va.

trons is collected at the anode giving rise to an electrical pulse, which can be recorded. One such pulse, or count, results from each initial interaction in the gas-filled detector. The pulses are totalized electronically in an instrument called a scaler.

2) A second method of radiation detection is the scintillation technique. The basis of this method is that when radiation interacts with certain materials, called phosphors, fluorescent light is emitted. This light is allowed to impinge on a photomultiplier tube, which converts it into an amplified electrical signal. The pulses are then totalized electronically with a scaler in the same manner as with gas-filled detectors. Both solid and liquid flourescent phosphors have been used.

3) A third technique, which is not as quantitative as the above two but which is more sensitive, is photographic emulsion. This method would be used for determining the location of very small amounts of radioactivity in a sample. The sample is placed next to a photographic film and the radiation causes an image on the film. This technique is called radioautography.

TEXTILE APPLICATIONS OF RADIOACTIVITY

The different types of applications of radioactivity to textile problems will be categorized into the following groups for discussion:

1) Laboratory investigations with tracer techniques
2) Analytical applications
3) Effects of atomic radiation on fibers and polymers
4) Plant process control

LABORATORY INVESTIGATIONS WITH TRACER TECHNIQUES——The basis upon which the isotopic-tracer technique is established is that a compound containing a radioactive isotope wil lexhibit the same phlsical and chemical properties as a nonradioactive compound. Therefore, the course or behavior of a nonradioactive material can be readily traced through detection of the radioactive present even though the labeled material is present in very small amounts.

Durability Testing of Finishing Agents. Undoubtedly, one of the most successful applications of tracer techniques to textile problems is the quantitative evaluation of the durability of a finishing agent, such as resins for water resistance, crease resistance, etc. Although the finishing agent may be a mixture, the main component is an organic polymer, which can generally be readily synthesized using radioactive carbon-14. The carbon-14-tagged compound can be incorporated into the finishing agent mixture and applied to the fabric in the same manner as is done in the normal operation.

TABLE II

Important reactor-produced beta- and gamma-ray-emitting radioisotopes

Element	Isotope	Half life	Energy of radiations	
			Beta	Gamma
Sodium	Na-24,	14.9 hours	1.39 mev	2.76, 1.38 mev
Iron	Fe-55	2.91 years	none	0.0062 (x rays)
Iron	Fe-59	46.3 days	0.46, 0.27, 1.56	1.10, 1.29, 0.19
Cobalt	Co-60	5.2 years	0.32	1.33, 1.17
Iodine	I-131	8.05 days	0.61, 0.34, 0.25, 0.81	0.36, 0.28, 0.64, 0.08
Cesium	Cs-137	33 years	0.518, 1.18	0.662*
Thulium	Tm-170	127 days	0.97, 0.88	0.084, 0.053 (x rays)
Iridium	Ir-192	74.5 days	0.67, 0.54, 0.24	0.32, 0.31, 0.30, 0.20
Gold	Au-198	2.69 days	0.97	0.411

*From daughter Ba 137.
Note: Radiations are listed in order of abundance.

The fabric can then be submitted to washing or dry cleaning treatments and the radioactivity measured to determine the percent retention of the labeled finishing agent. The fabric can then be submitted to repeated treatments and radioactivity measurements can be performed after each treatment. The tracer technique is uniquely powerful for such measurements, and the highly refined synthetic procedures currently available for the preparation of labeled compounds make the labeling of any textile-finishing agent feasible.

This method has been applied with marked success by Shapiro *(10)* in the testing of aqueous polyvinylacetate emulsion finishes used as "synthetic starch". He was able to evaluate the effects of the initial concentration of polymer and length and number of washings on the percent retention of the polymeric finish on fabric.

Detergency Testing Another very successful testing method based on the the tracer technique is the testing of effectiveness of detergents. Here synthetic radioactivity-labeled soiling matter is applied to the fabric and the radioactivity content determined after successive washings in exactly the same manner as in durability tests. The radioactive technique is more reliable and considerably more sensitive than other methods used in detergency testing, viz, light reflectance measurements on soiled cloth or light transmission of wash water.

A number of different types of radioactive soils and bacteria have been prepared using a variety of compositions and radioisotopes. Typical compositions that have been successfully employed include the following:

a) A buffered chromium phosphate (P-32 labeled) suspension which is combined with ordinary soil or grease *(11)*.

b) A bacterial suspension tagged with P-32 which can be mixed with ordinary soil *(11)*.

c) A synthetic soil consisting of 15 components including humus, fatty and colloidal substances, iron oxide and carbon-14 labeled carbon black *(12, 13, 14)*.

d) An admixture of radioactive fission products aged for six months or longer and inactive synthetic soil *(13, 14, 15)*.

e) Vegetable oils containing carbon-14 *(16)*.

An excellent article by Hensley and coworkers *(17)* describes techniques of preparation of "soiled" cloth, radioactivity measurements, wash test procedures, and equipment. They throughly discuss and compare results of tracer methods with more conventional methods and conclude that there is no "typical" natural soil and, therefore, completely reliable tests of performance would require use of a variety of test soils and methods of application. They state that the tracer method "appears to give evaluations free of some anomalies that have been recognized in conventional laboratory tests."

Mechanism Studies in Polymerization, Adsorption, Dyeing and Diffusion. A very powerful use of the tracer technique is its application to the complicated field of reaction mechanism studies. Considerable work has been devoted to elucidation of many organic reactions, but relatively little effort has been directed toward studying reactions of special interest in the textile field. A particularly fruitful field of investigations would be tracer studies on the function and fate of chemical catalysts in the production of resins and compounding of resin mixtures. Each of the components could be labeled in a series of experiments and their effect in the process separately evaluated.

Several excellent studies on applications of the tracer technique to adsorption, absorption, and diffusion phenomena have been reported. Salley and coworkers *(18)* have reported the measurement of adsorption of a water-soluble surface-active agent at a solution/air interface using sulfur-35 tagged materials. The method took advantage of the fact that, because of "self-absorption" of the weak sulfur-35 beta radiation by the solution and because molecules of surface-active agents are preferentially adsorbed at the interface, the radioactivity level above a solution containing an agent labeled with a weak beta emitter should be higher than that from a solution in which no surface adsorption occurs.

Wright *(19)* has described work on measurements of self-diffusion of hydrobromic acid in keratin using radioactive sodium-24 and bromine-82 and he was able to determine the self-diffusion coefficient and ionic mobilities using this technique.

A very important aspect of absorption mechanism investigation includes studies on the function of the various components in the dyeing process. White and coworkers *(20, 21, 22, 23)* have conducted extensive fundamental investigations along these lines, studying absorption of alkali metal bromides and sodium sulfate on human hair using radioactive sodium potassium, sulfur, and bromide. They also used an acid dye for wool tagged with radioactive sulfur in comparable absorption experiments *(22)*. Very recently, Moncrieff-Yeates and White *(24)* have reported work on use of tracer techniques in the study of absorption of various ions by cellulose from salt solutions and dyebaths. In a series of separate experiments, they measured absorption on cellulose of sodium, bromide, and sulfate ions from solutions containing a direct dye using sodium-22, bromide-82, and sulfur-35. They state that the use of radioactive tracers provided the advantages that the distribution of the individual ions could be determined and that sufficiently small quantities could be measured to permit use of single fiber samples which greatly simplified the problem of separation of fiber from entrained liquid.

Studies on the detailed mechanism of dye adsorption and migration in a fiber might be feasible by exposing it to radioactive tagged dye, microtoning thin slices of the fiber, and detecting penetration of radioactivity labeled material by radioautographic techniques.

TABLE III

Important reactor-produced pure beta-ray-emitting radioisotopes

Element	Isotope	Half life	Energy of radiation
Hydrogen	H-3	12.5 years	0.019 mev
Carbon	C-14	5700 years	0.155
Phosphorus	P-32	14.3 days	1.712
Sulfur	S-35	87.1 days	0.166
Calcium	Ca-45	164 days	0.25
Strontium	Sr-90	28 years	2.24*, 0.54
Thallium	Tl-204	4.0 years	0.77

*From daughter Y 90.

Studies of Fiber Movement During Drafting. An interesting application of tracers to studying a problem of considerable economic significance is the investigations conducted by Taylor *(25)* on the mechanism of movement of fibers during drafting. In the drafting process, a rope-like assembly of parallel fibers, called slivers, are reduced to a fine diameter by passing them through pairs of rollers where each succeeding pair of rollers moves at a faster speed than the preceding.

For perfect drafting, it is necessary for every fiber in the sliver to move at the speed of the back roller until it is gripped by the pair of faster-moving front rollers. Actually, at sometime during the passage between the rollers many fibers are free of both pairs of rollers and their movements are controlled by adjacent fibers. If these adjacent fibers are gripped by the front rollers, the free fiber may be accelerated without being stretched, thereby introducing irregularities in the drafted sliver.

Wool fibers made radioactive by immersion in phosphorus-32-labeled phosphoric acid were inserted in wool slivers at intervals along its length, and the sliver drawn through several rows of pins to obtain parallelism of the fibers. The movement of the individual tagged fiber was traced by the use of two Geiger counters. One of the counters was fixed in place at the back roller and the other counter was mounted such that its position could be varied to detect any point in the drafting zone.

The studies were conducted to determine what percentage of fibers of a given length accelerated over varying distances.

ANALYTICAL APPLICATIONS ——Extremely powerful analytical techniques have been developed using radioactivity methods, but only very limited use has thus far been reported in textile problems.

Isotope Derivative and Isotope Dilution. Two important analytical techniques utilizing radioactivity are illustrated in the method for the elucidation of polymeric structure of proteins, such as silk and wool, in studies by Levy and Slobodiansky *(26)*. The two methods are called "isotope derivative" and "isotope dilution." The "isotope derivative method" consists of reacting a compound such as an amino acid, with a radioactivity-labeled reagent, such as *p*-iodophenylsulfonylchloride tagged with I-131, to obtain a radioactive derivative. When this reaction is carried out on a mixture of compounds, such as is obtained from a hydrolysis of a protein, there results a mixture of radioactively labeled derivatives.

The amount of each species present in the complex mixture can be determined using a modification of the "isotope dilution" technique. The "isotope dilution" method *(27)* is used for determining the composition of complex mixtures where no quantitative isolation procedure is available. A known amount of radioactivity-labeled compound is added to the mixture. The compound is then isolated from the mixture and the specific activity (activity per millimole) is determined and compared to that of the added tagged compound. The extent of dilution of the tracer, ie, the lowering of the specific activity, indicates the amount of inactive material present in the original unknown material.

In the study on the hydrolysis of silk, the reverse of this technique was used to determine the amount of radioactivity-labeled derivative originally present by adding known amounts of inactive material of derivatives suspected of being present. The mixture of derivatives was then separated and each compound purified, weighed, and its radioactivity content measured. The ratio of the final specific activity obtained to the activity which would have been present if all the molecules were tagged is (w/w + W), where W is the weight of the carrier added and w is the weight of the unknown component.

Micro-Estimation of Amino Acids Using Copper-64. A method that might be considered a modification of the "isotope derivative" technique is the procedure for micro-estimation of amino acids developed by the laboratories of the Wool Industries Research Association in England *(8)*.

The method consists of two parts: 1) separation of amino acids from one mg to 10 mg of protein hydrolysate by the technique of partition chroma-

tography, and 2) determination of amounts of amino acid by the preparation of an amino acid complex with radioactive copper-64 and then measurement of the radioactivity incorporated in the complex. The sensitivity limit of this technique is 10^{-8} g of amino acid.

Activation Analysis. An analytical technique for trace quantities of elements which is receiving increasingly wide-spread use in a variety of fields is activation analysis *(28)*. The basis of the method is the *inducing* of radioactivity in an inactive sample by exposing it to neutrons from a reactor or a high-voltage machine. The radioactivities induced in the sample can be identified by appropriate nuclear instrumentation and they are indicative of the chemical elements present in the sample. Known trace quantities of elements suspected of being present are irradiated along with the unknown sample to provide comparative standards for quantitative measurements.

The sensitivity of the method depends on the flux of neutrons available, the counting efficiency of the radiation measurement equipment, and the following three factors which vary with each element—the cross section or probability for the neutron-induced nuclear reaction, the abundance of the target isotope, and the half life of resultant radioactivities. Microgram and submicrogram quantities of at least seventy elements in many types of materials have been detected by this technique.

Activation analytical services are available from the Oak Ridge National Laboratory, and facilities for neutron irradiation which will be suitable for activation analyses are becoming increasingly available with the construction of new reactors and development of neutron generators. No specific applications of this technique to textile problems have thus far been reported, but undoubtedly, these methods will receive considerable attention in the future.

EFFECTS OF ATOMIC RADIATION ON FIBERS AND POLYMERS ———A field of work that holds considerable industrial potential is the utilization of high energy ionizing radiation to produce physical and chemical changes in materials. Fundamental investigations have been underway for some years, studying the mechanisms of radiation-induced effects on simple chemical systems. But only within the past few years have there been enough large sources of ionizing radiation to direct efforts toward industrial applications. Sources of high energy radiation that are used for such purposes are: radioactive isotopes produced in nuclear reactors, such as cobalt-60; nuclear reactors themselves; radioactive waste fission products; and high-voltage machines. Marked changes in physical and chemical properties of many materials can be effected, though the detailed mechanisms by which such changes occur are extremely difficult to elucidate.

Figure 2
Continuous measurement of weight per unit area with beta gauges

Of particular interest to the textile industry are investigations of the radiation effects on natural fibers on synthetic polymers, and in the initiation of polymerization of monomers. Limited amounts of work have been reported thus far from studies on radiation-induced changes on natural and synthetic fibers *(29, 30, 31, 32, 33)*. Some of the effects that are evaluated are changes in affinity for dyes and strength of yarn.

Charlesby *(34, 35)* in England has reported investigations on several polymers. Two basic effects can be observed: 1) "cross-linking"—ie, the building up of the molecular weight through fracturing of side chains to form radicals and then combination of these radicals, and 2) "degradation"—ie, the fracturing of the main chain of a polymer and reduction in molecular weight or breaking up of crystalline structure. Changes of both a "cross-linking" and "degradation" character can occur simultaneously. The resultant physical changes depend on the molecular structure of the polymer and on the radiation exposure. For example, the following polymers primarily undergo "degradation"—cellulose, polyisobutylene, polytetrafluoroethylene. However, both "cross-linking" and "degradation" occur in polyethylene, some acrylic esters, and dimethyl siloxane, with "cross-linking" predominant.

Recently Gilfillan and Linden have reported the effects on cotton of gamma and neutron irradiation from a reactor *(31)* and electrons from a high-voltage machine *(33)*. Results indicated that irradiated cotton has lower affinity than normal for direct dyes and greater affinity than normal for basic dyes. The effects on dyeing were influenced by the large amounts of oxycellulose formed during the irradiations.

It is likely that the irradiation of polymers that undergo the "cross-linking" process will have more industrial importance since the resultant physical changes from enhanced "cross linking" lead to higher softening points, greater hardness and lower solubility. The "degradation" process may, however, be of value, particularly in textile research, eg, where degraded samples of known molecular weight of cellulose are of interest.

Another intriguing aspect of this field is the possibility of radiation-initiated preparation of new polymers that would be valuable as synthetic fibers. The radiation could be utilized in two ways: 1) to initiate polymerization of monomers that have proved to be resistant to polymerization by conventional methods of heat, light and chemical means; and 2) to prepare a new polymer of desired properties by grafting onto an existing polymer chain a different monomeric unit that could modify properties of the basic polymer, such as dyeing affinity, solubility, or electrical characteristics. Within the next few years, it is hoped extensive experimental efforts will be directed along the above lines, as great practical potential appears to be present in this field.

PLANT PROCESS CONTROL———Up to now, extremely limited applications of radioactivity have been made in textile plant processes, though several promising uses have been considered.

Continuous Measurement with Beta Gauges. A potentially very important and widespread application of radioactivity to automation of plant process is the use of beta gauges in the control of addition of finishes and coatings in padding operations. Beta gauges are devices developed to continuously measure the weight per unit area of sheet or web-like material without contacting the material being gauged. If a fabric passes through a process in which it picks up appreciable additional wet-weight (greater than 30-40% of initial weight) beta-gauge measurements can be calibrated to indicate takeup.

The response changes of the beta gauge can be utilized to actuate

equipment for the automatic control of processes. Examples of applications in which accurate, continuous wet-weight takeup control could be of extreme value are: coating of fabrics with resin finishes, the preparation of unwoven fabrics by binding of matting with resins, and coating of fabrics with latex or vinyl plastics. Calculations have been made on measurement of impregnated fabrics which indicate wet-weight takeup can be readily measured and controlled within a precision of $\pm 5\%$ of the wet weight of coating. Generally two gauges are utilized—one to measure the base fabric and one to measure fabric after takeup. If the base stock is sufficiently uniform, it may be possible to achieve a precision of $\pm 5\%$ using only one gauge to measure the takeup and not gauging the base fabric.

It is in applications such as this that the most immediate use of radioactivity in control of process operations is foreseen, since the radioactive material is completely contained and encapsulated and is very simple to employ. The practical use of beta gauges in the coating of fabrics with latex and in the paper, plastics, and metal industries has been demonstrated with no special problems due to the radioactivity encountered.

The basic principles of operation of beta gauges are relatively simple *(36, 37)*. There are two types of gauges —"absorption" and "backscatter." The most commonly employed type of gauge and the one that would probably be used for the applications cited above is the "absorption" gauges. In this case an encapsulated radioactive material, such as strontium-90, krypton-85, cesium-137, is placed on one side of the sheet material and a radiation detector, such as an ionization chamber, placed on the other side. The amount of the radiations absorbed is a function of the weight per unit area of the material being measured, and the response of the radiation detector can be so calibrated. The particular radioisotope to be used is chosen on the basis of the thickness of the material being gauged—the thicker the material, the more energetic should be the radiation. For example, krypton-85 is used to measure thicknesses up to 15 oz/yd^2, cesium-137 up to 30 oz/yd^2, and strontium-90 for thicker materials.

"Backscatter" gauges have the radiation source and detector in one unit on the same side of the sheet material. Essentially the same principle is employed here as in the absorption gauge except in the "backscatter" gauge the radiations penetrate the sheet material, reflect off a backing plate, and are then backscattered through the material before being measured.

Use of Radiation for Elimination of Static Charges. As mentioned previously, whenever nuclear radiation interacts with matter, ionization is produced. This property of radiation can be utilized to eliminate static charges accumulated by yarn or web as a result of friction *(7)* since radiation-induced ionization in the air acts to neutralize static charge. Static problems are most acute with nylon and acetate fibers, particularly in atmospheres where the relative humidities are low, since removal of static charge in a dry atmosphere is minimal.

The radioactive material, such as a beta emitter—strontium-90, krypton-85, or thallium-204, or an alpha emitter—polonium-210, is used in form of an encapsulated source such as those in beta gauges. Therefore, operational problems associated with the handling of the radioactive material are minimized since the radioactive material is completely enclosed.

The radiation sources are mounted within an inch or two of the charged surfaces to utilize most efficiently the densely ionizing ability of the alpha or beta radiation. Gamma radiation sources are not employed for such purposes since the radiations are too penetrating and are not sufficiently densely ionizing unless present in quantities too large to handle conveniently.

Use of Radioactive Tracers in Process Control. Suggestions have been made for the incorporation of radioactive tracers into plant processes for control of padding operation, roller printing, lubrication of yarn, dye concentrations in dyebaths, and manufacture of viscose rayon. The only actual plant uses of tracers thus far reported have been made by Hampson and his coworkers in England in the control of roller printing *(38)* and padding operations *(39)*.

In principle, radioactive tracers can be used for process plant control if the following conditions can be fulfilled.

1) If an isotope of short enough half-life, such as two weeks or less, is used.

2) If finished product can be stored long enough for activity to have decayed to some very small amount or if the radioactive material can be washed from the finished goods.

3) If proper precautions are taken during the actual process in handling of the radioactivity.

Futher tracer control techniques can be devised, but the economics of their use must be evaluated through studies which consider the balance between savings obtained from accurate, automatic control and the extra costs associated with the precautions necessary in handling radioactivity as a tracer in a plant process. The cost of the radioactivity itself would be negligible. Approval for use in this country of radioactive materials other than radium and polonium must be obtained from the U S Atomic Energy Commission, which evaluates safety aspects of each application.

The application to roller printing *(38)* was developed to avoid the problem of color soiling, ie, when an "offending" color migrates to the color box of a "sensitive" color. A radioactive isotope is mixed with the "offending" color and the amount of radioactivity adjusted to correspond to a known concentration of dye. The color box of the sensitive color is equipped with a radiation detector, such as a Geiger counter. During printing, some of the "offending" color will migrate to the "sensitive" color box, but its concentration can be continuously measured by the level of radioactivity. When this level reaches what has been determined to correspond to a "soiling" level, the "sensitive" color is replaced with fresh color.

In padding processes, it is essential that the padding liquor be uniformly distributed throughout the fabric being padded. The use of a radioactive tracer in the padding liquor affords a continuous check on the processes by detecting variations in concentration of the liquor and the amount of material deposited on the fabric. The continuous nature of the method offers considerable advantages over the spot checking of the cloth or assay of the padding liquor. It is particularly valuable in pad dyeing of resist salts or in naphthol coupling where variations in amount of chemicals deposited on the fabric can be noted before the cloth is printed.

The method, developed by Hampson and Jones *(38)*, consists of tagging a resist salt solution with phosphorus-32. Two radiation detectors were used, one to check the padding liquor to ensure that the correct amount of radioactivity is associated with a given weight of material to be applied to the cloth, the second geiger counter to monitor the cloth after it has been padded and dried. Any vari-

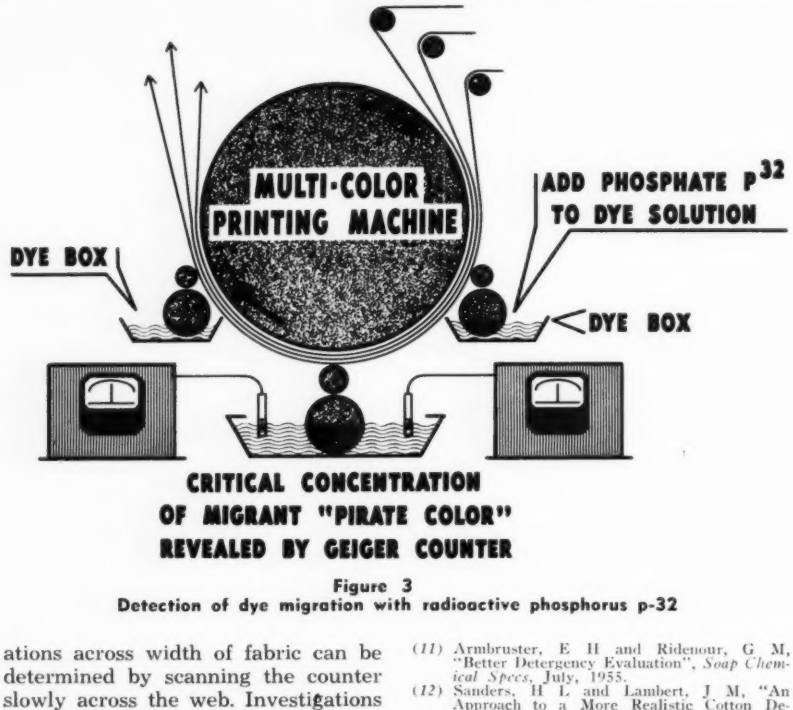
MULTI-COLOR PRINTING MACHINE
ADD PHOSPHATE P32 TO DYE SOLUTION
DYE BOX
DYE BOX
CRITICAL CONCENTRATION OF MIGRANT "PIRATE COLOR" REVEALED BY GEIGER COUNTER

Figure 3
Detection of dye migration with radioactive phosphorus p-32

ations across width of fabric can be determined by scanning the counter slowly across the web. Investigations on applicability of the method to resin impregnation measurement were still underway at the time their article was published.

CONCLUSIONS

Pioneering work has been started in applying radioactivity to problems in the textile industry. However, much experimental investigation remains to be done before the full potential of radioactivity in textile applications can be evaluated and utilized.

ACKNOWLEDGEMENTS

The valuable help of William Karp and Jennie Gaum in the preparation of this article is gratefully acknowledged.

REFERENCES

(1) Comar, C L, "Radioisotopes in Biology and Agriculture, Principles and Practice," McGraw-Hill Book Co, Inc, New York (1955).
(2) Kamen, M D, "Radioactive Tracers in Biology. An Introduction to Tracer Methodology," 2nd Edition, Academic Press, New York (1951).
(3) Bradford, J R, ed, "Radioisotopes in Industry," Reinhold Publishing Corp, New York (1953).
(4) Bleuler, E and Goldsmith, G J, "Experimental Nucleonics", Reinhart, New York (1952).
(5) Crompton, C E, "The Use of Radioisotopes in the Textile Industry", *Am Dyestuff Reptr* **42**, No. 17, P533-8 (August 17, 1953).
(6) White, H J, Jr, "Application of Radioactive Tracer Techniques to Textile Research", *J Soc Dyers Col* **70**, 284 (1954).
(7) Krobil, H E, "Radioisotopes—Their Use in the Textile Industry", *Atomics* **7**, 323 (1956).
(8) Robson, A, "Some Applications of Radioactive Isotopes in Wool Research", *ibid* **4**, 320 (1953).
(9) Pinault, R W, "What Radioisotopes Can Do for Textiles", *Textile World* **107**, 77 (1957).
(10) Shapiro, L, Private communication.
(11) Armbruster, E H and Ridenour, G M, "Better Detergency Evaluation", *Soap Chemical Specs*, July, 1955.
(12) Sanders, H L and Lambert, J M, "An Approach to a More Realistic Cotton Detergency Test", *J Am Oil Chemists' Soc* **27**, 53 (1950).
(13) Lambert, J M, Roecker, J H, Piscatore, J J, Segura, G, Jr and Stigman, S, "How to Prepare and Use Radioactive Soils", *Nucleonics* **12**, No. 2, 40 (1954).
(14) Segura, G, Jr, Snell, C T, Stigman, S and Snell, F D, "Detergency as Applied to Radiobiological Decontamination", *Chemistry & Industry* 1270 (1953).
(15) Snell, F D, Segura, G, Jr, Stigman, S, and Snell, C T, "Detergents for Radiological Decontamination", *Soap San Chem* **29**, No. 10, 42 (1953).
(16) *Chem Week* **75**, 64 (1954).
(17) Hensley, J W, Kramer, M G, Ring, R D, and Suter, H R, "A Detergency Test Method Using Radioactive Carbon Black Soil", *J Am Oil Chemists' Soc* **32**, 138 (1955).
(18) Salley, D J, Weith, A J, Jr, Argyle, A A, and Dixon, J K, "Measurements of the Adsorption of Surface-Active Agents at a Solution/Air Interface by a Radiotracer Method", *Proc Royal Soc* **A 203**, 42 (1950).
(19) Wright, M L, "The Interaction of Ions with Keratin", *Trans Faraday Soc* **50**, Part 1, 89 (1954).
(20) White, H J, Jr, and Underwood, D L, "The Use of Radiotracers to Study Absorption by Hair", *J Soc Cosmetic Chem* **7**, No. 2, 198 (1956).
(21) Underwood, D L and White, H J, Jr, "The Absorption of Sodium Sulphate and Sulfuric Acid by Hair", *Discussions Faraday Soc* **16**, 66 (1954).
(22) Stam, P B, and White, H J, Jr, "The Application of Radiochemical Techniques to the Study of the Interaction of Hair Fibers with Aqueous Solutions", *Textile Research J* **24**, 785 (1954).
(23) Barnard, W S, Palm, A, Stam, P B, Underwood, D L and White, H J Jr, "The Interaction of Hair Fibers with Alkali Bromide Solutions", *Textile Research J* **24**, 863 (1954).
(24) Moncrieff-Yeates, M and White, H J, Jr, "The Interaction of Cellulose with Simple Salt Solutions and with Dyebaths", *Am Dyestuff Reptr* **45**, No. 3, P87-96 (February 11, 1957).
(25) Taylor, D S, "Some Observations on the Movement of Fibres During Drafting", *J Textile Inst* **54**, No. 4, T310 (1954).
(26) Levy, M and Slobodiansky, E, *Cold Spring Harbor Symposium on Quantitative Biology* **14**, 113 (1949).
(27) Rosenblum, C, "Improving Quantitative Analysis", *Nucleonics* **14**, No. 5, 58 (1956).
(28) Leddicotte, G W, "Activation Analysis—What Can it Do For You", *ibid* **14**, No. 5, 46 (1956).
(29) "A Compilation of Abstracts Dealing with the Effect of Nuclear Radiation on Polymers and Fiber-Forming Materials", Department of Textile Research, School of Textiles, North Carolina State College.
(30) Kirby, R D and Rutherford, H A, "The Effect of Nuclear Radiation on Wool Fiber", *Textile Research J* **25**, 569 (1955).
(31) Gilfillan, E S and Linden, L, "Effects of Nuclear Radiation on the Strength of Yarns", *ibid* **25**, 773 (1955).
(32) Teszlar, O and Rutherford, H A, "The Effect of Nuclear Radiation on Fibrous Materials. Part I. Dacron Polyester Fiber", *ibid* **26**, No. 10, 796 (1956).
(33) Gilfillan, E S and Linden, L, "Some Effects of Nuclear Irradiation on Cotton Yarn", *ibid* **27**, No. 2, 87 (1957).
(34) Charlesby, A, "Atomic Radiation Treatment of Polymers", *Research* **8**, 288 (1955).
(35) Charlesby, A, "Beneficial Effects of Radiation on Polymers", *Nucleonics* **14**, No. 9, 82 (1956).
(36) Faulkner, W H, McKewen, G E, "Radiation Gaging of Plastic Sheet", *Automation* (June, 1956).
(37) Corwin, G, "Thickness Control by Beta Gages", *Modern Plastics* (March, 1955).
(38) Meitner, W and Hampson, H B, "Radioactive Isotopes in Roller Printing", *J Soc Dyers Col* **69**, 283 (1953).
(39) Hampson, H B and Jones, E W, "Control of Padding Process by Radioactive Labeling", *ibid* **69**, 620 (1953).

Q and A

Question: What is the sensitivity of the radioactive tracer technique?

Answer: A radioactively labeled material can be detected at a concentration in the order of parts per billion.

Q: I understand a device has been developed known as the gamma milker whereby extremely short-lived radioisotopes can be obtained in the laboratory from long-lived radioisotopes. Would you explain how this is possible?

A: If a radioactive isotope decays to an isotope which itself is radioactive, the pair of radioisotopes is called a parent and daughter. When the parent activity is long-lived and the daughter short-lived, a source of short-lived radioactivity can be available in the laboratory if the parent and daughter can be readily chemically separated. Ion-exchange resins can be very conveniently used for such separations.

One of the most useful parent-daughter pairs is Cs^{137}-Ba^{137} where the short-lived daughter, Ba^{137} (2.6 min half-life) can be readily separated or milked from the long-lived parent Cs^{137} (30 yr half-life) using ion-exchange columns.

With such a technique, an essentially inexhaustible supply of short-lived activity is available from the long-lived parent.

Q: When a material is exposed to a given dose of gamma radiation, will the induced effects be the same if the period of exposure is varied from a short to a long time?

A: In the radiation-induced polymerization of monomers, there is no question that variation in intensity (ie, dose rate) of irradiation leads to greatly different effects of molecular weight and per cent conversion to polymer. When polymers are irradiated, there may also be a "dose rate" effect. It undoubtedly is less marked, but in some cases, it may be significant.

Report——

192ND MEETING
Technical Committee on Research

THE 192nd meeting of the Technical Committee on Research was held in the Hotel Roanoke, Roanoke, Va, on Saturday afternoon, March 30, 1957, under the chairmanship of Charles A Sylvester.

This special meeting, which was open to all attending the 1957 Spring Meeting of the Piedmont Section, was designed to better acquaint members of the Section with the functioning of TCR.

Introductory remarks were made by George O Linberg, president of AATCC; Harold W Stiegler, AATCC director of research; and Mr Sylvester. Following this, spokesmen for five TCR committees, covering fields of special interest to the Southern textile industry, presented reports on the activities of their respective committees as follows: "Wash and Wear"—George S Wham, Jr; "Colorfastness to Washing"—Ralph B Smith; "Colorfastness to Light"—Joseph E Norton; and "Damage Caused by Retained Chlorine" — Richard F Aurich. P J Fynn, in the absence of John H Warner, spoke on "Dimensional Changes in Textile Fabrics."

The text of Mr Sylvester's introductory remarks and the reports of Messrs Smith, Norton, Aurich and Warner follow. Dr Wham's report for the Committee on Wash and Wear will be submitted at a later date and will be published by itself.

* * * *

INTRODUCTORY REMARKS

CHARLES A SYLVESTER
Chairman, Technical Committee on Research

THE Technical Committee on Research appreciates the privilege of participating in the technical program of the Piedmont Section. That the American Association of Textile Chemists and Colorists is a recognized authority in the field of test methods is an unchallenged fact. Its test methods are being accepted more and more as integral parts of the realistic end-use specifications being established in the trade today. One has only to glance through CCC-T-191b, CS 59, L-22 and L-24 to appreciate this fact. These test methods are one of AATCC's important contributions to the textile industry through its Technical Committee on Research.

It is our sincere opinion that the revision and refinement of old tests and the development of new tests can best be effected on a national scale through TCR. The Technical Committee on Research with over 100 members representing all segments of the textile industry is organized for this purpose. By channeling the needs and requests for new test methods through TCR considerable duplication of effort can be avoided not only within the AATCC but within other associations as well. We are always striving to do a better job and for this reason welcome advice and constructive criticism so that the functions of TCR can best be directed to serve you.

As a contribution to your technical program, we will try to give you a clear picture of the activities and plans of several AATCC Subresearch Committees. It is regretted that the time factor limits us to reports of the work of only five of the thirty-eight active research committees.

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COMMITTEE ON COLORFASTNESS TO WASHING

RALPH B SMITH, *chairman*

THE textile industry uses test procedures for the control of manufacturing operations and the quality of the finished product. They play an essential part in the development of new products by indicating expected consumer experience. They form an integral part in the specification of textile properties in informative labeling, in the shirt standards of the National Association of Shirt, Pajama and Sportswear Manufacturers, in American Standards L22 and L24, and in the recently issued standards of the Textile Distributors Institute.

The ideal test method is a relatively simple laboratory procedure, the results of which indicate consumer experience with regard to the property covered by the test. The degree to which this ideal can be achieved depends on the type of property under test and the extent to which accelerated test methods can be made to duplicate use results. In the case of the three accelerated washfastness tests, it has been possible to design them so that the test results are a direct indication of the washfastness of textiles to commercial laundering and home washing.

The 2A, 3A and 4A tests cover the range of machine washing from lukewarm water and neutral soap up to and including washing at 160° F with bleach. Conditions, which have developed in the few years since these tests were published, now make it desirable to expand the range covered.

Informative labeling and the various textile standards already referred to, cover, in the case of many fabrics, the complete range of restorability; ie, from drycleaning to hot-water washing with bleach. The old wetcleaning test, which was once generally used in connection with the colorfastness to drycleaning, has been largely eliminated from textile specifications such as L-22. This area of colorfastness is now referred to as "hand washable," but we have no authentic test for this level of washability.

Fabrics in this range are presumably those having some degree of washability below that covered by the 2A test.

The Committee on Colorfastness to Washing has taken steps to find fabrics in this range of colorfastness. These will be subjected to simple hand-washing methods, and the technique used in developing the present accelerated tests will be applied at Lowell to develop a laboratory test procedure which will simulate the results of hand washing.

At the upper end of the washfastness scale are the vat-dyed workclothes fabrics, which, because of the use they receive, must often be washed by methods that give very high detergency, particularly with regard to greasy soil. Such washing formulas are characterized by high

alkalinities, low soap usage and temperatures of 180° F or over, produced by admitting steam into the wash-wheel during the sudsing operations. No bleach is used in these formulas, but even so, they provide a very severe test of even the best and properly applied vat dyes.

The first series of field tests on work clothes fabrics was carried out in 1955 on eight vat-dyed cotton twills of the type used for work clothes. In these tests one series of samples was washed by the type of industrial overall formula already described and the other by a commercial laundry in the family white work classification at 160° F with bleach. These samples exhibited a considerable variation in the rate of color loss and in the development of crow's feet, the latter being produced by the abrasion of fold lines formed during washing. The gray-scale ratings for color loss and the rate of development of crow's-feet were not too different in the two methods of washing, but there was some indication that, on the average, the industrial overall formula produced somewhat more color removal and abrasion.

These original tests were carried out by the Committee on End-Usage Performance Tests. It was the feeling of that Committee that future field tests should be made before work on the development of a laboratory method was started at Lowell and also, that the whole problem should be turned over to the Committee on Colorfastness to Washing for further work.

The fabrics used for the second series of field tests were made up of additional yardage corresponding to the original eight samples plus four olive-green khaki fabrics, which were obtained from the Quartermaster Research and Development Command through Frank Rizzo.

The field washing tests were carried out by three industrial overall laundries, using their regular washing methods, and by Good Housekeeping Institute, using homewashing procedures. In order to more closely simulate actual end-use conditions, the test specimens were made up into pant legs, and each industrial laundry and Good Housekeeping Institute was supplied with three sets of the pant legs, which were washed 5, 10 and 20 times respectively. These pant legs, after washing, were returned to Lowell where they were rated for color removal on the basis of the International Gray Scales. Cone Mills also determined spectrophotometer Y values (brightness), and rated color loss and crow's feet visually on one set of samples.

A number of observations may be made on the basis of the results obtained on the washed samples:

1) 3A and 4A tests produce the same loss of color on a given sample.

2) There is a very close correlation between the results of the home washing procedure and the 3A and 4A tests.

3) The gray-scale readings showed that there was a difference in the amount of color removed by the three industrial laundries.

4) Seven of the fabrics, after 20 washings, showed gray-scale ratings of 2 for all three industrial laundries. Five fabrics showed mixed 1 and 2 gray-scale readings. A gray-scale rating of 2 corresponds to six NBS units of color difference and a rating of 1 is equivalent to twelve NBS units. The pieces having a gray-scale rating of 1 after 20 washings show a very considerable loss of color.

5) Raw-stock dyeing does not eliminate crow's feet or improve colorfastness over conventional methods.

6) The development of crow's feet in the various samples washed 20 times by the industrial laundries varied from good to poor. Crow's feet are due to abrasion marks and appear to follow the fold lines which form during washing. They do not develop noticeably in the first washing but appear to develop with repeated washing, from which it can be inferred that the folds tend to redevelop in the same location in succeeding washings. This condition with regard to fabric folds is characteristic of closely woven fabrics, such as twills, which were used in these tests. Anything which increases the flexibility of the fabric should tend to reduce the formation of crow's feet.

7) The different fabrics tested showed sufficient variations in dye removal and in the formation of crow's feet to indicate that a test method can be developed to measure colorfastness with respect to this type of washing. Possible modifications of the 3A test to this end have already been considered by the Committee.

8) It may be possible to improve the washing formulas used by industrial laundries so as to reduce the rate of dye removal, while at the same time maintaining adequate detergency.

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COMMITTEE ON COLORFASTNESS TO LIGHT

JOSEPH E NORTON, *chairman*

THIS committee has been actively engaged in a number of projects. Some of these have been completed recently, and in others the work has progressed to a point where we are now ready to present and publish some of our findings. This report will attempt to inform you briefly of our progress to date and our plans for future work.

Some time ago our supply of the AATCC Blue Wool Lightfastness Standards became exhausted, so that it became necessary to prepare a new lot. This would appear to be a fairly simple task, but it proved quite difficult to provide a new lot which would exhibit both the same fading rate and characteristics. Under the guidance of Frank Rizzo, this project has now been completed and the standards are again available from the Secretary of AATCC. The standards may be ordered individually in cuts of 18″ x 28″ of each standard instead of by complete sets of all seven standards as they were previously sold.

About three years ago several of our corporate members approached the Committee on Colorfastness to Light for information which would explain why the daylight exposure test specified by some of their customers as a condition of acceptance was at one time passing their material and at another time rejecting it.

The daylight exposure test in question called for no appreciable change in color after exposure to a specified number of ultra-violet sun hours under glass in South Florida. For this test, an ultra-violet sun hour was defined as a total cumulative time of one hour during which the radiation intensity was above the level of .823 gm cal/cm^2. Further inquiry into the method revealed that, in the conducting of this test, the specimens were placed in a ventilated cabinet under glass where they were allowed to remain 24 hours a day until they had received the specified number of ultra-violet sun hours. No standards were employed and the specimens were credited with exposure time only when the radiation level was above .823 gm cal/cm^2.

To members of our committee and others with extensive experience in the variables of lightfastness testing, this method on a time basis without standards would obviously produce

quite wide differences in tests since it, by inference at least, had to assume that no fading occurs below the level of .823 gm cal/cm^2 and that above that level the rate of fading was uniform regardless of the intensity level.

To provide reliable authoritative information on this and other variables encountered in lightfastness testing, it was decided to set up a subcommittee under the chairmanship of C H A Schmitt.

Initially, three test sites (Chicago, Miami and Phoenix) were available for use by the subcommittee. Each was equipped with Pyrheliometers and recording equipment. For the first series of tests, twenty-eight dyeings, 6 each on spun nylon and rayon, wool, cotton and 4 commercial fabrics were employed. Tests on these were conducted at the three locations; for three consecutive months, July, August and September, and by three methods.

Method A was a daylight exposure in which the specimens and standards were left in the cabinets under glass 24 hours a day uncovered. Methods B and C both were sunlight tests in which the specimens were exposed essentially between the hours of 9 AM and 3 PM or when the radiation level was above .823 gm cal/cm^2. In methods B and C the samples received exactly the same amount of radiation, but those in method B were covered and left in the cabinets whereas those in Method C were removed from the cabinet and taken indoors whenever the level dropped below .823. This was done to determine if their being left in the cabinet and thus subjected to additional temperature and overnight moisture caused additional change of color. In all three methods of this series the specimens were exposed until they had received a total of 45 ultra-violet sun hours.

As was anticipated, the fading produced by a given number of so-called ultra-violet sun hours at different times and locations varied so greatly that it was quite obvious that tests made on this basis were completely unreliable and should not be used as a basis of acceptability or for the rating of dyed textiles.

At the same time as the first series of tests, we, in Chicago, in special automatically shuttered cabinets, exposed the same specimens and standards to equal total amounts of radiation for each specimen at various levels of radiation intensity. In each cabinet the shutters were open only when the radiation intensity was in the range of that cabinet, so that the samples in that cabinet were exposed only to radiation of that particular intensity level. For the first cabinet the intensity range was .1 to .823, the second .823 to 1.0, the third 1.0 to 1.2 and the fourth above 1.2.

Results of this series demonstrated that, regardless of the intensity range, equivalent amounts of radiation or total Langleys produced a reasonably close amount of color change. The amount of time required to produce an equivalent total amount of radiation or Langley units of course varied proportionally to the intensity.

In the Summer of 1956 additional work was repeated to determine if there was some intensity level below which no significant fading occurs. For this test the cabinets were adjusted so that the first was open in the range .1 to .4, the second .4 to .6. the third .6 to .823 and the fourth above .823. Results from this set of tests further confirmed our original contention that significant fading does occur below the level of .823 and that, regardless of the intensity range, equal total amounts of radiation or Langley units will produce reasonably close amounts of color change.

Since in the previous series there appeared to be correlation between the total radiation received and the fading produced, we decided to investigate exposures made on a total Langley basis. This first series was conducted during the winter and early spring of 1956, but only at Miami and Phoenix since the winter weather made testing at Chicago impractical. On the basis of exposure until a specified number of Langleys had been received, this series produced good correlation from time to time at the same location, between the two locations and by the three exposure methods.

The correlation in this series had been excellent but an examination of the exposure data indicated that the exposure conditions had been very similar. To see if the fading remained uniform under wider variations of exposure conditions it was decided to follow up the winter and early spring exposures with repeat tests in the summer months and to expand the program to include some of the synthetics. In addition to the three test locations previously employed, an additional station at Sarasota was now available to the Committee for this series.

From past work, we did not feel that it was necessary to run this series under all three conditions, so the B condition where the specimens were explosed to sunlight but covered whenever the radiation level dropped below .823 was omitted. For this service we thus had 56 specimens and AATCC Blue Wool Standards exposed under both daylight and sunlight test methods at four locations.

All of the exposures under the two exposure conditions and at all four locations for each specimen were exposed to the same number of Langley units or total amount of radiation. The number of Langleys to which each dyeing was exposed varied considerably and was based on a previous determination of the number of Langleys required to produce a grade 4 color contrast on the gray scale.

In general the amount of fading produced by both methods at all four locations was in fairly good agreement. There were, however, a few of the specimens which did fade more in the daylight test and more particularly in those exposures where a larger proportion of the total radiation received was below the level of .823. We now believe that there are some dyeings, which for want of a better term we are calling moisture-sensitive, that fade more in the presence of moisture. It has been our observation that, at low radiation intensities, such as early in the morning or on cloudy days, there is very little temperature rise in the sample due to absorbed radiation so that the moisture content of the samples is more nearly in equilibrium with that of the surrounding air whereas under higher levels of radiation there is a larger rise in the temperature of the specimen and a corresponding drop in its actual moisture content.

This and other phases of natural light exposures are being continued and will be reported on as information is developed. There are indications that with certain restrictions, interpretations and possibly auxiliary moisture-sensitive standards it may be possible to develop a satisfactory daylight test based on Langley units. But for the present our AATCC Blue Wool Lightfastness Standards are the only reliable means of expressing the lightfastness qualities of textiles.

While the sunlight test, now our official AATCC test. is more reproducible, the Committee now feels that a daylight test employing our AATCC Blue Wool Standards is a more desirable test in that it more nearly reproduces actual end-use conditions and also requires less time for completion. We are therefore submitting to TCR for letter-ballot approval a new daylight exposure

method to replace our present sunlight exposure method. This same daylight exposure method will also be submitted by the USA delegation for consideration as an ISO method.

All concerned with lightfastness testing and rating should realize that rating a textile against the standards by one exposure will provide only limited information as the relationship between a dyeing and the standards may be considerably altered under widely varying conditions of exposure.

This committee will continue its work of evaluating both methods of use and all available equipment for artificial light tests.

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COMMITTEE ON DAMAGE CAUSED BY RETAINED CHLORINE*

RICHARD F AURICH, *chairman*

THE Committee on Damage Caused by Retained Chlorine has had as its primary objective, since its formation in 1948, the development of a reproducible test method correlated with laundering practice that would reveal the chlorine-retentive characteristics of a textile fabric or finish with respect to potential fabric damage.

Initially, work was confined to rayons because it was from aminoplast resin-treated rayons that most of the dissatisfaction and complaints of retained chlorine damage stemmed. In the course of subjecting resin-treated and untreated rayons to a series of cumulative commercial launderings, it was early apparent that, at the standard low level of available chlorine concentrations used, appreciable fabric damage was not sustained. Hence, it was decided early to use accelerated conditions in a test method that would show marked damage on rayons treated with an ordinary urea-formaldehyde paste resin.

Consequently a great deal of effort went into experimentation over a period of time in evolving Tentative Test Method 69-52 which first appeared in the AATCC *Year Book* in 1952. This was recognized as being inadequate by the original committee for the even-then-known requirements, but the urgency due to the many complaints on damage necessitated that a tentative procedure be made available until a final method could be formulated and accepted. The method has since remained as initially published except for the 1956 *Year Book*, wherein a disclaimer was appended. This was in keeping with the Committee publication of February 27, 1956 in the *American Dyestuff Reporter* summarizing its position on the status of the test method.

At about the same time that the Tentative Test Method was first published, the problem of damage due to retained chlorine on resin-treated cottons became critical. This generally renewed and generated wider interest in the phenomenon of chlorine retention.

Therefore, in 1953, heeding the comments and suggested changes that the published method had prompted, and also, taking cognizance of the admitted shortcomings of the published method, the Committee drew up a revised procedure. This procedure is the same in principle as that previously published; however, it took into account that the large number of variables in the test method would have to be precisely controlled and the conditions very exactly specified if interlaboratory correlation or reproducibility were to be achieved.

In essence, the method for determining the chlorine-retentive characteristics of a textile fabric or finish consists of five main steps: 1) prewetting; 2) chlorination per se, wherein time, temperature, pH, liquor-to-cloth ratio, and available chlorine content are specified; 3) rinsing; 4) scorching at 365° ±2° F for 30 seconds; and 5) the tensile strength determinations before and after scorching after proper conditioning. It is to be appreciated that four of the five main steps are quantitative in the sense that an attempt is made to limit or control a reaction, or to measure the effect of such a reaction. It is therefore obvious that errors introduced through lack of precision or specification can be readily cumulative. Also, certain of the operations must, by their very nature, have limitations placed on them, eg, the chlorination must be limited to preclude degradation through oxycellulose formation, and the scorching conditions must be specified short of pyrolysis degradation in heating an untreated cotton.

Starting then in 1953 the Committee began to evaluate the revised test procedure for reproducibility and interlaboratory correlation. Difficulty was encountered in the very first interlaboratory test which led the Committee on to many devious and intricate interlaboratory tests and individual experimentation to isolate the source or sources of difficulty.

One or two of these interlaboratory tests are interesting enough to be included here if for no other reason than to show the extent of the experimentation performed. The scorching step was early one of the steps suspect in attaining correlation, so an attempt was made to isolate it as a source of the difficulty. An interlaboratory test was conducted wherein the participating laboratories were supplied with swatches of resin-treated fabrics with instructions to chlorinate on a certain day and send the chlorinated rinsed patches to a specified laboratory where all swatches were scorched and returned to have tensile strength breaks made after proper conditioning. Concurrently, one laboratory was supplied with a sufficient quantity of the same fabric to chlorinate and then send to individual laboratories to be scorched and broken at specified times. Not only did this fail to pin point scorching as the source of trouble but better correlation was achieved in the individual scorching than in the individual chlorination. Consequently, this led to an interlaboratory test wherein one member supplied a common source of standard hypochlorite to be used on experimental fabrics. This again failed to achieve correlation.

Work continued in this vein for some two years and led to various refinements in the revised test procedure and the introduction of various artifices to achieve interlaboratory correlation.

During the course of our experimentation, new problems arose. One especially merits mention in even this brief report and that is the problem of colored-yarn fabrics. In the use of Tentative Test 69-52 by the trade, it was found that ordinary nonresin-treated colored-yarn fabrics manifested a serious degree of damage. What we are faced with here, of course, is a phenomenon of long standing in the preparation of cotton fabrics—the classic danger of the formation of chloramines from nitrogenous impurities in partially prepared cottons—the resulting reaction being precisely that of chlorine retention in resin-treated cottons with respect to subsequent damage on heat exposure. These fabrics have, of course, been in use for many years and, therefore, must be assumed to be, and actually are, fully commercial fabrics. Thus, our work is further

*NOTE: See pages P237-43 of the April 8, 1957 issue of *Am Dyestuff Reptr* for a review of the activities of this Committee from 1953-1956.

complicated in attempting to avoid penalizing such fabrics by having them show up poor in any test method developed.

In spite of the vast amount of time and work that have gone into the aforementioned experimentation, our goal has thus far eluded us. One point we have achieved—reproducibility within a laboratory. However, we have not achieved interlaboratory reproducibility or correlation with practice. Also, all of the problems we are confronted with have only become clear through the great deal of work already performed by the Committee, and it may be sometime further in the future when all aspects and ramifications of the problem stand in clear relief.

Our previous experience has shown us, however, how slow our progress would be if continued with our old approach. Consequently, in late 1956, the groundwork was laid to more expeditiously facilitate the Committee's work. At the November meeting, the Committee voted adoption of a proposal for a new approach, and an extensive program was then drawn up to implement the voted proposal.

The basic features of this program are twofold: 1) the establishment of six task forces or subcommittees to simultaneously explore different facets of the problem, and 2) the establishment at Lowell of a research project to investigate certain aspects of the problem particularly with respect to the precision of the revised test procedure.

The specific assignments of the task forces are as follows:

1) to determine the choice of resin, catalyst, and/or other additives to be used as the standard finish or finishes by other committees in their experimental work. Also, to study the behavior of various types of resin finishes using the revised test procedure.

2) to study the effect of variations in the prewetting and chlorination steps of the procedure.

3) to study all facets of the rinsing operation, scorching procedure, and the effect of varying conditioning times of the revised test procedure.

4) to determine the performance in commercial and domestic launderings of the standard fabrics and finishes to be used and the correlation of same with the revised test procedure results as obtained by those committees experimenting with standard finishes and fabrics.

5) to determine the behavior of colored yarns and nonresin finishes, including chlorine-sensitive dyestuffs and various textile auxilaries, eg, certain cationic softeners.

6) the steering committee, which will pass on test method revisions and publications, coordinate the work of the various subcommittees, and direct the research project at Lowell and act as liaison between it and various subcommittees.

Specifically the project at Lowell will have as its objectives:

1) to establish equipment for performing the revised test procedure with the utmost control and reproducibility of every conceivable variable.

2) to determine how reproducible the test is under such conditions.

3) to determine how variable damage due to retained chlorine is within a piece of fabric.

To carry out such a program as outlined necessitates securing a large amount of uniform or standard fabric. The scope of the program precludes depending on voluntary contributions of fabrics and finishes. There are several reasons for this, but the primary one is to eliminate the confusion that has resulted in the past from having a different fabric and finish every time an interlaboratory test is conducted. Consequently, the Executive Committee on Research was petitioned and made available $1000 to cover the purchase and finishing of approximately 3000 yds of fabric estimated for our needs. Authorization was also granted by the Executive Committee on Research for establishment of the project at Lowell.

The various task forces or subcommittees have since held organizational meetings and outlined programs which have been approved by the steering committee. Arrangements have been made for the purchase and finishing of standard fabrics to be used in the program. The steering committee has met with Lowell to establish and lay the groundwork for the project to be carried out there. Thus, our program is well underway.

In view of our past progress and the obstacles encountered, it is not with unbridled optimism that we look to the future in our work. But this we do know, that lack of success will in no way be due to lack of effort.

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COMMITTEE ON DIMENSIONAL CHANGES IN TEXTILE FABRICS

JOHN F WARNER, *chairman*

DURING the past two years, the Committee on Dimensional Changes in Textile Fabrics has concentrated its efforts to devise test methods for determining the dimensional changes of fabrics during laundering for various levels of washability regardless of fiber content or fabric construction. It is recognized that AATCC Test Methods for Dimensional Changes in Textile Fabrics are inadequate to cover the large volume and variety of fabrics which are available to the consuming public. The test methods available are as follows:

1) Dimensional Changes in Cotton and Linen Textiles, Standard Test Method 14-53.
2) Dimensional Changes in Textiles Other than Cotton and Linen, Tentative Test Method 40-52.
3) Shrinkage of Wool Hose: Accelerated Test, Tentative Test Method 73-53.
4) Relaxation and Felting Shrinkage of Wool Knit Fabrics: Accelerated Test, Tentative Test Method 74-53.
5) Dimensional Changes in Wool Textiles: Accelerated Test, Tentative Test Method 41-52.

Added stimulus to revise the system of test methods into general levels of washability regardless of fiber content or fabric construction resulted when the May 3, 1955 issue of *Daily News Record* reported a "5-grade Label Plan Begun for Garment Washability" by an Inter-Industry Committee on Apparel Cleaning and Serviceability consisting of the following groups: National Institute of Drycleaning; American Institute of Laundering; National Association of Retail Clothiers and Furnishers; Associated Men's Wear Retailers of New York; NRDGA and NASPJM. The five grades proposed by this group are as follows:

1) Completely Washable
Garments so labeled can be washed any way at all within reason except at temperatures over 160° F, including bleach, if necessary.

2) Fully Washable—Do Not Bleach
Garments can be washed same

as above except that colors are not fast to bleach.

3) Wash in Warm Water—Do Not Bleach
Wash at the low temperature settings on washing machines. Temperature should not go over 120° F, which is still very hot to the touch, but much safer for these colors than labels 1 or 2.

4) Wash by Hand in Lukewarm Water—Do Not Bleach
Just as the label says. Water temperature is comfortable to the hand.

5) Dryclean
For best results, garments so labeled should be drycleaned.

It was the aim of the Committee on Dimensional Changes in Textile Fabrics to set up a series of shrinkage tests covering all classes of washable fabrics by which it would be possible to predict the dimensional stability of any washable fabric under its normal conditions of washing. As a result of this work, it was anticipated that it would be possible to define a graded series of dimensional stability characteristics in much the same manner as is now used to rate the washfastness of colored fabrics.

A subcommittee was formed and instructed to prepare a graded series of washing procedures representative of those used by commercial laundries and in the home and to make other related recommendations as to test procedure. This subcommittee prepared four separate reports in carrying out its assigned task. During this part of the work the main committee decided that it would be desirable and helpful to publish the information as an article entitled "Practices Followed in Laundering Textiles" in the *American Dyestuff Reporter*.

The subcommittee prepared this paper which includes details of procedures used in commercial laundries and in home laundering. In summary, these procedures are as follows:

A) *Washing Procedure of Commercial Laundries*
Procedure 1———White work washing
Procedure 2———Fast colors
Procedure 3———Colors of moderate fastness
Procedure 4———Wool wash

B) *Home Laundering Procedure*
Procedure 1 ——— Machine washable white or fast color fabrics
Procedure 2 ——— Machine washable fabrics of moderate colorfastness.
Procedure 3 ——— Machine washable fabrics that require care in handling because of fabric or garment construction
Procedure 4———Hand washable because of low colorfastness, fabric or garment construction.

In addition to the details of times, temperatures, and concentrations during washing, the paper lists the drying and finishing procedures used by the commercial laundry or in the home.

The present status of this paper is that the committee has supplied copies to a committee of home laundry equipment manufacturers for suggestions and comments. This group has agreed to submit their comments and evaluation of the home laundering techniques to us, and the Committee on Dimensional Changes in Textile Fabrics hopes to have the paper ready for publication in the near future.

This subcommittee has outlined the major variables involved in the development of service data through interlaboratory tests. Eleven woven and five knitted fabrics of seven different fibers have been suggested to be included in the first study, the participating laboratories have been named, and the conditions of test have been stipulated. The Committee requires a minimum of 60 yards of each fabric for these tests and is trying to obtain these fabrics from interested manufacturers at no cost to AATCC, if possible.

During this preliminary survey of procedures used by commercial laundries and in the home, a second subcommittee was assigned the task of developing a laboratory test method for determing shrinkage resulting from hand washing. This subcommittee conducted interlaboratory tests as follows:

Washing Procedures

1) AATCC 40-52
2) CS59-44, Section 18
3) CCC-T-191a, Section 14 (at 100° F)

Finishing Procedures (for each washing procedure)

1) Air dried
2) Air dried, sprinkled and flat-bed pressed
3) Air dried, sprinkled, hand shaped and pressed
4) Air dried, sprinkled, pressed on rotary ironer
5) Extracted, flat-bed pressed
6) Extracted, hand shaped and ironed
7) Extracted, pressed on rotary ironer.

Each of the fabrics tested was washed also according to ASA L-22 Standards and restored on the tension presser with weights as prescribed in the test method and once again with half-pound weights regardless of shrinkage values obtained after flat-bed pressing.

Analysis of this interlaboratory data indicated that AATCC Test Method 40-52 did predict accurately and with reproducible results the dimensional changes which occurred during hand washing. A second series of interlaboratory tests by three participating laboratories was conducted on 49 fabrics of various fabric constructions, various fiber contents ranging from 100% of one fiber to blends of three fibers in one fabric, and in ounces per square yard weights varying from 2.4 to 13.8. The samples were washed by hand and by AATCC Method 40-52 five times each and dimensional changes recorded after the first, third and fifth wash.

This data was analyzed by the main committee which then voted to recommend that AATCC Test Method 40-52 be revised under *Purpose and Scope* to read as follows:

"This test determines the amount of shrinkage or stretch of fabrics when subjected to hand laundering or its equivalent in commercial laundering. It is applicable to fabrics made up of fibers other than wool."

This recommendation was made before a meeting of TCR and the motion was passed to make the changes in the *AATCC Year Book* recommended by the Committee on Dimensional Changes in Textile Fabrics.

During the interlaboratory tests conducted on the development of a handwash test procedure, the problem of dimensional restorability characteristics of fabrics was encountered and discussed by the main committee. Dimensional restorability was defined tentatively as the amount of stretch which can be imparted to a fabric by usual methods of home laundering without damaging the fabric permanently. The committee members agreed that dimensional restorability characteristics exhibited by many fabrics and a means of measuring this property required a great deal of research which no one on the committee was free to accomplish on a voluntary basis. The committee requested that the AATCC Research

Headquarters study the mechanics of fabric shrinkage and develop a restorability test for woven fabrics as a research project. AATCC Research Headquarters accepted this research project and is working on the development of a test method for dimensional restorability of fabrics.

The Committee on Dimensional Changes in Textile Fabrics agreed to proceed with its work to develop test methods reporting flat-bed-press shrinkages. *Dimensional Restorability* was then defined as the maximum amount of stable change that can be induced by stretching or wearing a fabric measured on the basis of the fabric when washed and flat bed pressed according to a standard shrinkage test procedure. Such a test would reflect the minimum amount of dimensional change in end use.

The AATCC research staff surveyed the literature concerning the subject of shrinkage testing and concluded that for general use and for purposes of reproducibility, the AATCC Dynamic Dimensional Change Meter would offer the best possibilities in measuring dimensional restorability because:

1) Several known conditions of test could be created
2) A minimum of fabric would be necessary
3) The number of possible variables due to handling or to human error would be minimized
4) The test specimens could be kept under close observation at all times
5) The instrument could be operated by a person having average intelligence
6) A test could be completed in a reasonably short time.

The Committee also suggested to the AATCC research staff the possibility of obtaining a stress-strain curve on a 1-inch ravelled strip grab tensile strength test of the washed sample in order to determine whether some physical, identifiable point on the curve could relate dimensional restorability characteristics. Yardage of three fabrics known to exhibit dimensional restorability qualities has been submitted to the AATCC research staff for its experimentation. Although the Committee outlined the problem of dimensional restorability and made suggestions for possible solutions, the AATCC research staff has complete freedom to develop any new equipment which may be necessary to establish a test method for determining the dimensional restorability of fabrics as defined.

One Committee member suggested that a comprehensive study of the mechanics of fabric shrinkage be included in this project; however, all members did not agree to the necessity of spending research funds for investigating the theory of fabric shrinkage unless it had a direct bearing on the practical solution to the problem of determining dimensional restorability as defined. The Committee will compose a letter to be mailed to various textile schools suggesting that undergraduate or graduate students undertake the study of the mechanics of shrinkage as a thesis project. The Committee will attempt to help the student by supplying materials with which to work at no cost to him.

The Committee has received a request regarding a problem encountered in measuring dimensional changes of blanket fabrics using AATCC Test Method 40-52. In the testing of blankets, it is necessary to have a visual appraisal test before and after washing. Since AATCC Test Method 40-52 causes a severely disturbed blanket face due to the long time of agitation, the request was made to develop one test which would serve both purposes; ie, shrinkage and appearance change at a considerable saving in time and expense. The Committee has agreed to consider whether the present AATCC Tentative Test Method 40-52 does in fact represent an adequate minimum handling washing test procedure for determining dimensional stability of specialized fabrics such as blankets.

In summary, the Committee on Dimensional Changes in Textile Fabrics has performed the following work during the past two years:

1) Prepared a paper listing the methods of washing in use by commercial laundries and in the home.
2) Recommended a test procedure for determining the dimensional changes occurring in fabrics (other than wool) when subjected to hand washing or its equivalent in commercial laundering.
3) Instituted research work on the development of a procedure to determine dimensional restorability characteristics of fabric.
4) Outlined interlaboratory test procedures for developing test methods for determining dimensional changes of textile fabrics according to a level of washability regardless of fiber content or fabric construction.
5) Agreed to consider request for help in the solution of a specific problem involving dimensional changes and appearance change of specialized fabrics such as blankets.

AATCC Calendar

COUNCIL
June 7 (Hotel Statler, New York)

NATIONAL CONVENTIONS
Nov 14-16, 1957 (Hotel Statler, Boston); Oct 30-Nov 2, 1958 (Hotel Conrad Hilton, Chicago); 1959 (Sheraton Park and Shoreham Hotels, Washington, DC); Oct 6-8, 1960 (Sheraton Hotel, Philadelphia, Pa); September 28-30, 1961 (Buffalo, NY)

DELAWARE VALLEY SECTION
Sept 27 (Joint meeting with New York Section at Hotel Hildebrecht, Trenton, NJ); Nov 1 (Kugler's Restaurant, Philadelphia, Pa); Dec 6 (Kugler's Restaraunt, Philadelphia, Pa)

HUDSON-MOHAWK SECTION
June 21 (Outing—Antlers Country Club, Amsterdam, NY)

MID-WEST SECTION
June 14-15 (Outing—Brown's Lake Resort, Burlington, Wis); October 26, Bismarck Hotel, Chicago, Ill)

NIAGARA FRONTIER SECTION
June 21 (Annual Outing—St Catherines, Ont); Sept 27 (Buffalo); Oct 25 (Joint meeting with CATCC Ontario Section at St Catherines, Ont); Dec 6, Feb 21 (Buffalo); Apr 4 (Joint meeting)

NEW YORK SECTION
June 21 (Outing—North Jersey Country Club, Wayne Twsp, NJ); Sept 27 (Joint meeting with Delaware Valley Section at Hotel Hildebrecht, Trenton, NJ)

NORTHERN NEW ENGLAND SECTION
Sept 13 (Outing—Wachusett Country Club, W Boylston, Mass); Dec 6 (Annual meeting, Hotel Continental, Cambridge, Mass)

PIEDMONT SECTION
June 7-9 (Outing—Mayview Manor, Blowing Rock, NC); Sept 28 (Hotel Barringer, Charlotte, NC)

RHODE ISLAND SECTION
June 14 (Outing—Warwick CC and Rocky Point, RI); Sept 27 (Ladies Night—Narragansett Hotel, Providence, RI); Oct 24 (Providence Engineering Society, Providence, RI); Dec 5 (Annual Meeting—Johnson's Hummocks Grill, Providence, RI)

SOUTH CENTRAL SECTION
June 21-22 (Outing—Lookout Mtn, Tenn); Sept 20 (Hotel Patton, Chattanooga, Tenn)

SOUTHEASTERN SECTION
June 7-9 (Outing—Radium Springs Ga); Sept 14 (Harmony Club, Columbus, Ga); Dec 7 (Dinkler Plaza Hotel, Atlanta, Ga)

WESTERN NEW ENGLAND SECTION
June 14 (Outing—Wallingford, Conn); Sept 27 (Rapp's Restaurant, Shelton, Conn); Nov 1 (Annual meeting, Hartford, Conn. area); Dec 13 (Rapp's Restuarant, Shelton, Conn)

Activities of the Local Sections

Past chairmen and their time of service are as follows: Peter F O'Neill, 1927-1928; Leslie L Bamberger, 1929; R S Wheeler, 1930; Noel D White, 1931-2; Harold Schroeder, 1933-4; Walter E Hadley, 1935-6-7; Nestor Grotelueschen, 1938-9; Fletcher L Kibler, 1940-1; Jack Anderson, 1942-3-7; Homer Whelchel, 1944; Frank F Myers, 1945; Clyde J Horne, 1946; Raymond B Seymour, 1948; Wilbur K Newman, 1949; Joseph H O'Neill, 1950; William G Agnew, 1951; Howard P Loveless, Jr, 1952; Everett E Burgner, 1953; Paul O Anderson, 1954; Joe T Bohannon, Jr, 1955; William H Luther, 1956.

South Central

PAST chairmen of the South Central Section were honored on the occasion of the Section's 30th anniversary meeting, held April 27, 1957 at the Hotel Patten, Chattanooga, Tenn.

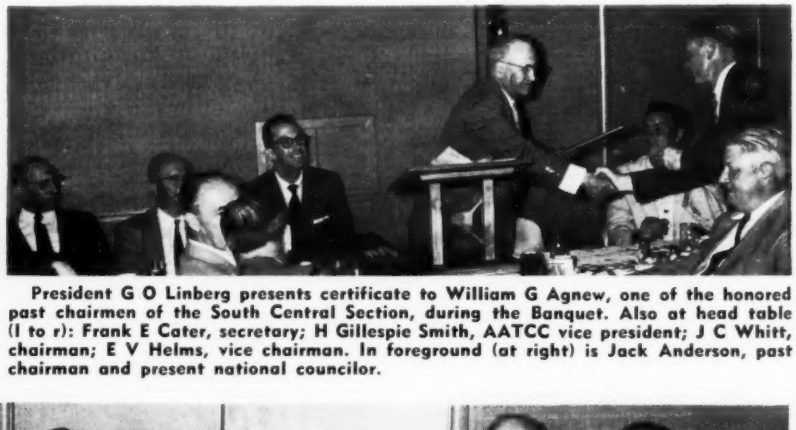
All past chairmen present were presented with framed certificates in recognition of the services of each to the Section. Tribute was paid to past chairman Walter E Hadley, recently deceased, and all other deceased past chairmen: Peter F O'Neill, the first chairman; R S Wheeler; Noel D White, and Harold Schroeder.

In attendance at the meeting was national president George O Linberg and H Gillespie Smith, vice president (Southern Region).

Fred McKenna, research advisor, Institute of Textile Technology, Charlottesville, Va, discussed "The Use of Ultrasonics in Dyeing and Wet Processing" at the afternoon technical session.

The South Central Section was organized April 30, 1927.

(L to r): H Gillespie Smith, AATCC vice president (Southern Region); J C Whitt, chairman, South Central Section; George O Linberg, AATCC president.



President G O Linberg presents certificate to William G Agnew, one of the honored past chairmen of the South Central Section, during the Banquet. Also at head table (l to r): Frank E Cater, secretary; H Gillespie Smith, AATCC vice president; J C Whitt, chairman; E V Helms, vice chairman. In foreground (at right) is Jack Anderson, past chairman and present national councilor.

New York

THE April 26th meeting of the New York Section attracted a banner turnout of 350 at Kohler's Swiss Chalet, Rochelle Park, NJ. Vice-chairman John Komninos presided in the absence of Chairman Donald E Marnon, who was ill.

The technical part of the evening's program included two papers: "Procion Dyestuffs" by Raymond Thornton, Arnold, Hoffman & Co, and "Dyeing Blends of Dacron Polyester Fiber and Cotton or Rayon" by J J Iannarone, Jr, E I du Pont de Nemours & Co, Inc.

Mr Thornton pointed out that the Procions are primarily for the cellulose fibers but also have application for nylon, natural silk and wool. The fact that they have no affinity for some of the newer synthetic fibers, for example, Dacron and Arnel, also has a technical significance in that novel resist effects are obtained in the dyeing of fiber blends.

Past chairmen who were present at the April 27th meeting of the South Central Section (l to r): Jack Anderson, Wilbur K Newman, Everett E Burgner, Howard Loveless, Jr, William G Agnew, Joe T Bohannon, Jr, Paul O Anderson, Frank F Myers, William H Luther, Joseph H O'Neill, Homer Whelchel, and Fletcher L Kibler.

Mr Iannarone, in his paper, cited dyeing methods for blended fabrics containing Dacron, such as the Thermosol Process, yarn dyeing under pressure, conventional temperatures, etc. Sublimation and vaporization characteristics of the full line of disperse dyes for Dacron were defined, providing the basis for proper selection of dyes for each of the dyeing methods and end-use requirements.

* * *

Sidney M Edelstein, president, Dexter Chemical Corp, was the featured speaker at the New York Section's 1957 "Ladies Night" program held May 17th at Kohler's Swiss Chalet.

Dr Edelstein entertained the gathering of 125 with unusual and humorous stories related to the history of dyeing and finishing.

A cocktail party was held prior to the dinner.

* * *

The Section's annual outing and golf tournament will be held June 21st at the North Jersey Country Club, under the chairmanship of Chris W Farrell, Althouse Chemical Co.

Rhode Island

THE 3rd Annual Student-Member Night of the Rhode Island Section was held April 25, 1957 at the New Bedford Institute of Textiles and Technology, New Bedford, Mass, with approximately 100 students from NBITT, Bradford Durfee Technical Institute, Rhode Island School of Design and the University of Rhode Island in attendance. Kenneth Broden, Sherwin-Williams Corp, program chairman and toastmaster, introduced the speakers of the evening. Harry Riemer, editor, *Daily News Record*, spoke on "Textiles: A Great Basic Industry" and Arthur L Quirk, head of the Department of Physics, Univ of Rhode Island, discussed "Reactors—Their Uses and Their Products."

R F Caroselli, Owens-Corning Fiberglas Corp, chairman of the Section, presided at the dinner meeting, which was held following a tour of the Institute.

In attendance at the meeting were George O Linberg, AATCC president; Raymond W Jacoby, past president; and Ernest R Kaswell, vice president.

Assisting Mr Broden as cochairman and student representative was Joseph A Powers, chairman of the AATCC student chapter at NBITT. Faculty advisors assisting in the preparation of the program were; Harold Sturtevant, R I School of Design, George Parks, Univ of Rhode Island, and Carl Medde, NBITT.

(Photo courtesy of Kenneth C Everett)

R F Caroselli, R I Section chairman, presents books on dyeing to contest winners Lincoln A Bryant, Damiano E Caramante and Joseph A Powers.

The following students, winners of a slogan contest designed to encourage the use of textiles or to increase interest in textiles, were awarded books on dyeing: Lincoln L Bryant, Bradford Durfee Technical Institute; Damiano E Caramante, R I School of Design; and Joseph A Powers.

* * *

The previous meeting of the Rhode Island Section was held March 28th at the Providence Engineering Society, Providence, RI, at which time Wendall Brennan, assistant to the head of the Industrial Division, American Viscose Corp, spoke on "Fibers and Equipment Used in the Manufacture of Nonwovens", and Leonard Shapiro, administrative technical advisor, Chemical Div, The Borden Co, discussed "Developments in Emulsion Polymers for Woven and Nonwoven Fabrics".

(Photo courtesy of Kenneth C Everett)

HEAD TABLE AT RHODE ISLAND SECTION STUDENT NIGHT—*Front row (l to r):* William D Fales, head, Dept of Textiles, Rhode Island School of Design; George Walker, president emeritus, New Bedford Institute of Textiles and Technology; John Foster, president, NBITT; Raymond W Jacoby, past president, AATCC; Leslie Coombs, president, Bradford Durfee Technical Institute; R F Caroselli, chairman, Rhode Island Section.
***Back row (l to r):* James Giblin, dean, NBITT; Harry Riemer, *Daily News Record*, speaker; Ernest R Kaswell, vice president, AATCC; Arthur L Quirk, Univ. of Rhode Island, speaker; Kenneth J Broden, Sherwin-Williams Co, toastmaster.**

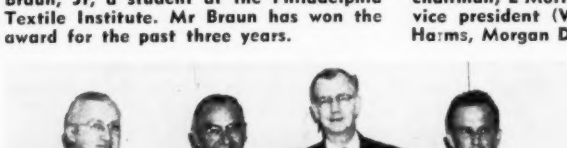
MID-WEST SECTION SPRING MEETING

April 27, 1957 • Netherland Hilton Hotel, Cincinnati, Ohio

(See meeting report on page P370 of previous issue)

J G Kelley (right), chairman of the Mid-West Section, presenting the Section's Annual Scholarship Fund Award to V C Braun, Jr, a student at the Philadelphia Textile Institute. Mr Braun has won the award for the past three years.

SPEAKER'S TABLE (l to r): V C Braun, Jr, winner of Mid-West Section Annual Scholarship Fund Award; J T Taylor, Rohm & Haas Co, afternoon speaker; N Hollies, Harris Research Laboratories, evening speaker; J G Kelly, E I du Pont de Nemours & Co, Inc, chairman; E Morrill, The Best Foods, Inc, vice chairman, Mid-West Section, and AATCC vice president (Western Region); W B Broadbent, Geigy Dyestuffs, secretary; K M Harms, Morgan Dyeing & Bleaching Co, treasurer.



T Heginbotham, E R Brunskill, N S Knaggs, J W Ertel

W La Vey, A A Coleman, J Nerl, W H Bultman, F S Stover, L B MacFarland, T Ratajczak, H T Latham, W T Grobe

E W Camp, W H Bultman, W La Vey, E Morrill

J Werden, E Roseberry, M Metze, J Jones, A Hultberg, E Stearns

G B Willgeroth, W A Corry, F H Gurry, Mrs Gurry, E Larrat

H W Dingee, J G Stott, H N Frey, E R Brunskill, E Brittan, E L Moore, T Heginbotham, L C Voss

Employment Register

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the secretary of the Association, Post Office Box 28, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the secretary.

57-9

Education: Northeastern Univ, BS, chemical engineering.

Experience: 20 years dye manufacturing—chief colorist; technical director; sales manager. All large firms. Excellent trade relationship.

Age: 46; married; references; resume on request.

Position desired: administrative—technical sales.

Location desired: open; now residing in Southeast. 5-20, 6-3

• PATENT DIGEST •

PAUL WENGRAF

WRINKLE-RESISTANT FINISH Based on Acrolein-Formaldehyde Condensates G,2,04

USPat 2,771,337 (Dan River Mills—Gagarine, Repokis——Nov 20, 1956)

The preamble to this specification states that most wrinkleproofed fabrics show insufficient resistance to commercial laundering and, moreover, an undesirable degree of chlorine retention. A prior patent application by the same inventors (apparently not yet matured into a patent) describes a finish based on a melamine-urea-formaldehyde condensate. While it is claimed to impart superior crease resistance, it admittedly does not withstand the severe conditions of commercial laundering where strong bleaches and/or highly alkaline soaps are customarily used.

A resinous product, prepared by the same inventors and protected by USPat 2,696,477 of Dec 7, 1954, consists of an alkaline condensate of acrolein and formaldehyde. The components may be reacted under pressure or by refluxing. A preferred catalyst is sodium carbonate, but a slower reacting organic catalyst of lesser basicity, such as methyl ethyl pyridine, may be applied instead.

According to the current invention, this resinous compound is adjusted to a pH of 2-2.5 after the reaction is terminated, applied to cellulosic textiles in this form in the presence of an *acidic catalyst*, such as $MgCl_2$ or $NaHSO_4$, and finally baked. It is emphasized, however, that the reaction product itself is *not a thermosetting acid-hardening resin*, but rather acts specifically as a cross-linking agent for the cellulose molecules. Excellent wrinkle resistance is claimed; moreover, no loss in tensile strength nor yellowing in strongly alkaline laundering occurs with this treatment in contrast to other formaldehyde-containing finishes. Any chlorine retention is said to be prevented while durable dimensional stability is attained.

A particular property of the acrolein-formaldehyde condensates, that of retaining this reactivity in the presence of polyhydric alcohols, is used in the preparation of a cornstarch-modified condensate adapted for special rayons or rayon blends. Corn starch is reacted with formaldehyde in one kettle, another contains the acrolein-formaldehyde condensate, and a third contains a 20% soda ash solution. A strongly exothermic reaction occurs when these three solutions are combined. Following the cooling and neutralizing operations, a crease-resistant, weight-increasing finish is obtained.

Among the references cited by the Patent Office:

USPat 2,441,859 (Alrose Chem Co/1948): cellulosic textiles are rendered shrink-resistant by an application of a formaldehyde-yielding agent in the substantial absence of acidic reagents [cf *Am Dyestuff Reptr* 37, 768 (1948)].

USPat 2,486,399 (Dan River Mills /1949): shrink-resistant effects are obtained by treatment with starch-aldehyde condensates combined with formaldehyde-acetone reaction products [cf *Am Dyestuff Reptr* 39, 99 (1950)].

USPat 2,657,192 (Du Pont/1953) describes the preparation of acrolein polymers for use as intermediates and cross-linking agents.

GAS-FADING PREVENTION ———Dialkylaminoacrylate Polymers Applied G,1

USPat 2,770,518 (Celanese Corp of America——Conciatori, Salvin——Nov 13, 1956)

An improved resistance to gas fading of acetate dyes (especially those of the anthraquinone series), which are otherwise sensitive to the action of acid fumes, can be attained by impregnating the fibers with polymeric dialkyl diaminoalkyl acrylates. The chain length of the alkyl and alkylene groups is limited to 6. An example is polydimethylamino ethyl methacrylate.

Application of these compounds in the form of their salts is said to confer gas-fading resistance quite generally; however, the effect is not resistant to washing by reason of their solubility. A durable washfast effect results when the goods are baked at 100° C or more for at least 5 minutes. The higher the baking temperature, the shorter the baking period. For example, an effect obtained in 30 minutes at 110° C reportedly is equal to that obtained within 5 minutes at 160° C.

Example: A satin fabric made with cellulose acetate yarns and dyed with 1, 4 dialkylamino anthraquinone was padded with 1% of the acetate salt of polydimethylamino ethyl methacrylate and dried. The color remained unchanged on exposure to 3 units of gas fading (AATCC standard). After the same specimen was baked for one hour at 110° C this effect withstood scouring in contrast to the nonbaked sample.

Among the references cited by the Patent Office:

USPat 2,138,762-63 (Du Pont/1938): addition salts of alkyl methylene carboxylic acid monomers and amino alcohols are polymerized to give dispersing and emulsifying agents of the dialkylamino ethyl methacrylate type.

DYEING OF SYNTHETIC FIBERS WITH ACID VATS ———Controlled pH Conditions and Temperatures Applied C,4,07

USPats 2,774,647-8-9 (Am Cyanamid——Mecco, Creely——Dec 18, 1956)

The three patents in common call for the application of acid vats, ie, reduced vat dyes in free hydroxyl form, in the dyeing of synthetic fibers (polyester, polyacrylic and cellulose acetate fibers) in a narrow pH range of 6-8 and preferably between 6.5 and 7.5. The exact pH value can best be maintained by buffering with tripolyphosphate or sodium tetraphosphate. Furthermore, dyeing must be carried out at elevated temperatures, but somewhat differently for each of the three aforementioned fiber groups according to their individual heat resistance.

A) *USPat 2.774,647.* Hitherto it has not been possible to dye polyglycol terephthalate fibers (Dacron) satisfactorily with vat dyes, but very good results are now said to be obtained by dyeing with a vat dye under above conditions at a temperature of 250-290°F, the upper limit being at 325°. For example, Dacron staple fiber was dyed a bright pink shade from a dyebath containing 6-6′-dichloro4-4′-dimethyl-2-2′ bis thionaphthene indigo, sodium hydrosulfite and sodium tripolyphosphate as a buffer, at 290°F. This was followed by re-oxidation with acid peroxide and washing with sodium dodecylsulfate solution. Dyeing took only a few minutes and showed good penetration of the fibers.

B) *USPat 2.774,648.* Polyacrylonitrile fibers are produced either by

dry-spinning from a solvent solution (diethyl formamide) or by wet-spinning both acrylic homo- or copolymers from a concentrated aqueous thiocyanate solution. This patent refers especially to the vat dyeing of wet-spun fibers. Here the limit in dyeing temperatures is also 325°F and practically from 160°F upward to around 300°F according to the heat resistance of the individual fibers. Yellowing of the fibers can be inhibited by adding salts of divalent metals to the aqueous dyebath. Salts of Zr, Mn or Mg prove to be best and Ca and Al are also effective in a somewhat lesser amount as antiyellowing agents.

Example: A wet-spun acrylonitrile-methacrylate copolymer yarn was dyed in a dyebath containing Calcosol Jade Green (*CI* 1101), sodium tripolyphosphate, sodium hydrosulfite, and some manganous chloride as antiyellowing agent. After the dyeing and alkaline soaping operations were completed, a bright green shade resulted. Most of the examples do not advocate specific oxidation, as development by air drying is generally sufficient. An important advantage is that more dye or reducing agent can be added at any time during dyeing, which is not feasible in regular vat dyeing procedure (Col 2, lines 42-47).

C) *USPat 2,774,649.* This patent refers to an analogous dyeing procedure with cellulose ester fibers. The temperatures used are from 160°F up to the boil. Also here, as in the preceding patent, exposure to air gives satisfactory results without the necessity of chemical oxidation.

Example: A skein of cellulose acetate filament was dyed in a bath containing Vat Violet 6R (*CI* 1212), sodium tripolyphosphate and hydrosulfite at the boil. After dyeing was complete the goods were washed in warm water, boiled in 5% soda ash solution, rinsed again and scoured with sodium dodecyl sulfate solution.

Among the references cited by the Patent Office:

to USPat 2,774,647:

USPat 1,900,172 (Celanese Corp of Am/1933): dyeing of cellulose esters with free leuco compounds of vat dyes.

USPat 2,627,449 (Luttringhaus et al/1953): dyeing of polyester fibers with leuco-vats by heating the material for a short period to 300-400°F [cf *Am Dyestuff Reptr* 42, 852 (1953)].

An article in *Am Dyestuff Reptr* 40, P681-84 (1951) by Choquette discusses the problem of vat dyeing of Orlon and Dacron, the latter being padded with vat acids and heat set for 3-5 min at 350°F.

to USPat 2,774,648:

USPat 2,646,339 (Celanese Corp of Am/1953): dyeing of cellulose ester fibers also other synthetic fibers (among them polyesters) with leuco vats, alkali carbonate, an alkanolamine and a solvent [cf *Am Dyestuff Reptr* 43, 215 (1954)].

to USPat 2,774,649:

USPat 1,900,172 (Celanese Corp of Am/1933): see above.

USPat 2,646,339 (Celanese Corp of Am/1953): see above.

USPat 2,524,073 (Celanese Corp of Am/1950): dyeing of cellulose ester fibers in the presence of diacetone alcohol with leuco vats [cf *Am Dye-Stuff Reptr* 40, 148 (1951)].

AFTERTREATMENT OF DIRECT DYEINGS———Dicyandiamide-Formaldehyde Condensates Plus Copper Salts C,4,01

USPAT 2,768,055 (Gen Aniline & Film Corp——Steck et al——Oct 23, 1956)

Aftertreatments of direct dyeings with aldehyde condensation products frequently affect the fastness of the shades; sometimes these compositions also lack solubility and stability. The object of the current invention is to increase wetfastness and lightfastness at the same time.

These results reportedly are attained by applying mixtures of *acidic dicyandiamide* condensates with formaldehyde combined with water-soluble copper compounds.

The acidic condensates are prepared by condensing 1.5-2.5 moles of formaldehyde with one mol dicyandiamide and 0.5—1.0 mol of an ammonium salt, preferably ammonium chloride (or another ammonium salt of a strong acid) in the presence of an alkaline buffering agent. The condensation product is acidic in nature, having a pH of 5.5-6.8 in aqueous solution. The presence of the ammonium salt is essential to the process. It is probable that the ammonium salt ionizes to liberate ammonium and acid ion, the former taking part in the condensation and forming an integral part of the condensate. The buffering agent, necessary for preventing precipitation of the copper salt, is sodium acetate or potassium acetate, also formate or borate or a corresponding ammonium salt.

The water-soluble copper salt may be acetate or chloride or any other copper salt that does not precipitate under working conditions. For 100 p of the above dicyandiamide condensate, 10-100 p of the copper salt and 10-50 p of the buffering agent may be employed.

Example: Dicyandiamide was charged into a 38% formaldehyde solution and ammonium chloride was added. The pH was 6.5. In an exothermic reaction, the temperature rose to 80°C and was increased to 95-98°C for several hours. Then the condensate was precipitated by running the solution into salt solution. It was mixed with one of the above copper salts and the buffering agent. Direct dyeings were aftertreated for 30 min with a 2% solution of the condensate at 160°F, rinsed and dried. No curing of the resin was required.

Among the references cited by the Patent Office:

USPat 2,364,726 (Ciba Prod/1944): aftertreatment of direct dyeings with precondensates of formaldehyde and nitrogen bases in general combined with copper salts.

USPat 2,526,106 (Ciba Ltd/1950): basic condensation products of dicyandiamide and formaldehyde (also guanidine or other nitrogen bases) are combined with complex copper compounds in solution [cf *Am Dyestuff Reptr* 40, 198 (1951)].

USPat 2,631,920 (Ciba Ltd/1953): improving the fastness properties of direct dyeings by a treatment with a dicyandiamide-formaldehyde condensate and a water-soluble copper compound [cf *Am Dyestuff Reptr* 43, 67 (1954)].

WAVED FINISH ON TEXTILES ———Compressive Shrinking Device Used G,4

USPat 2,768,092 (Cranston Print Works——Lawrence——Oct 23, 1956)

Waved finishes have been produced hitherto by means of an embossing calender, which requires engraved rollers. Moreover, the slow speed of this method is economically unsatisfactory for mass production.

The present invention is based on the use of a compressive shrinking machine as exemplified by the *Sanforizing process* (see reference below). The inventor succeeded in the modification of this equipment to obtain regular rippled or waved discontinuous effects, mainly perpendicular to the warp direction.

A fabric is first passed through a frictioning calendar and then a solution of resin-forming components, preferably of the thermosetting type, such as urea-formaldehyde, melamine-formaldehyde or ethylene urea-formaldehyde (the latter mentioned in the examples), essentially in monomeric or only partially polymerized state. From Figure 1, it can be seen that the fabric enters the compressive shrinking equipment between shoe (28) and blanket (26), surrounding drum (20), where the fabric is first

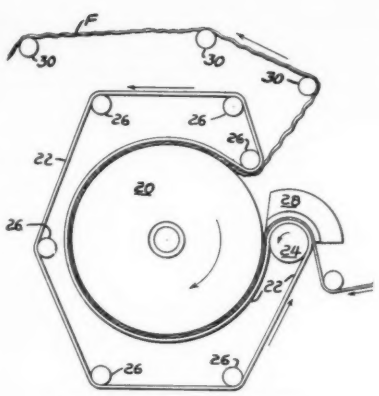


Figure 1—USP 2,768,092

stretched on its way over roll (24) and then compressed, as in the Sanforizing method. The essential innovation of the current invention is that the point of shoe (28) as well as the infeed roll (24) are *spaced a limited distance* (about 0.010 to 0.125 in) *from the surface of drum* (20) in contrast to standard "Sanforizing", where the point of the shoe and the infeed roll are almost in contact with the drum. This modification forces the fabric to travel for a short distance with a slightly greater speed and independent of that of blanket (22), thereby causing it to contract about 2-6% before it again contacts the blanket. Surprisingly, the ripples so formed do not flatten on their further way between (22) and (20), although the resin does not completely harden on the way around or after leaving the heated drum. *Complete* hardening on the drum might require undue slowing of the speed. An additional hardening passage through a conventional air drier is suggested.

Among the references sited by the Patent Office:

USPat 2,021,975 (Cluett, Peabody /1935) covers one of the main Sanforizing patents, which calls for moving the fabric through a path of varying curvature, whereby the surface of the drum-surrounding belt is first stretched and then compressed.

USPat 2,193,340 (Hampton Co /1940): producing plisse crepe fabrics in continuous operation by printing with a caustic shrinking paste in predetermined areas, applying moisture from the backside by spraying, rippling the web in a feed box and drying.

DYEING OF WOOL-ACRYLIC FIBER BLENDS———Certain Basic Dyes Used for Acrylic Portion C,4,07

USPat 2,772,943 (Du Pont——Hiller Jr——Dec 4, 1956)

Union- or cross-dyeing of mixed fabrics composed of wool and polyacrylic fibers is a problem that has not yet been solved satisfactorily. It has been observed that certain basic dyes are selective for the acrylic portion of the blend, dyeing this fiber group *at a pH of 3.0-5.0* without substantially staining the wool (or other fibers) blended therewith. The appropriate basic dyes are characterized by the absence of carboxylic or other acidic groups and strongly basic triphenylmethane structures. Examples of dyes which work well in this respect are Brilliant Green, Malachite Green, Methylene Blue, Safranine, Auramine, etc, and particularly a red and an orange dye of the cyanine class. *Unsuitable basic dyes,* which stain wool even under the above acid conditions, are, among others, the strongly basic triphenylmethane dyes Crystal Violet (*CI* 681), Victoria Blue R and B (*CI* 728 and 729), Rhodamine B (*CI* 749) and so on.

Dyeings are carried out preferably at or near the boil. Loosely held color from the non-acrylic fibers must be removed afterwards by scouring with soap or any other detergent.

Example: A wool stock blended 50/50 with drawn polyacrylic fiber was first dyed with one of the above basic dyes, and then, after being rinsed and scoured, with acid dyes, eg, Guinea Green (*C I* 666), Alizarine Supra Blue A (Pr 12), Pontacyl Light Yellow G X (*CI* 639), etc, to obtain contrasting color effects.

Other examples refer to a one-bath dyeing of a similar blend, which produced a uniform shade with a mixture of a basic and an acid green dye. A table is presented (col 3, lines 45-53), which proves the relative affinity of a basic dye (Brilliant Green) to polyacrylic fibers compared with a minimum absorption by wool, regenerated and esterified cellulose, nylon and Dacron.

Among the references cited by the Patent Office:

Am Dyestuff Reptr 38, P925-8 (1949) (Thomas and Meunier) reports on dyeing methods for Orlon acrylic fibers, including application of basic, vat and other dyes.

DYEING OF MIXTURES OF WOOL AND ACRYLIC FIBERS ———Staining of Wool by Basic Dyes Prevented C,4.07

USPat 2,764,466 (Du Pont——Bidgood Jr——Sept 25, 1956)

The preamble to this patent refers to the above USPat 2,772,943 (Serial 306,936). Although the latter method is said to work well, it has been observed that in some cases the wool portion becomes stained even at low pH values. The object of the current invention is to improve the method and to obtain clear color shades on each fiber category.

This objective might be attained by dyeing the basic dye from a dyebath containing 2.5-15% bw of an organic (acetic or hydroxy acetic) acid and a nonionic agent, such as Emulphor O (USPat 1,970,578), Pluronic F-68, Carbowax 400 or Tween 80. The nonionic surfactant, essential for the purpose of avoiding staining of the wool portion, is added in an amount of 0.1-2.0% (of the fiber's weight). Dyeing is carried out at 160-250°F.

Example: A 50/50 blend of wool-polyacrylic fiber was dyed in a bath containing a yellow basic dye (Astrazon Yellow 3G), a green basic dye (Brilliant Green-*CI* 662), a red basic dye (Magenta-*CI* 677), and a red acid dye (Pontacyl Carmine 2G-*Ci* 131). The polyacrylonitrile fibers were dyed a neutral grey, the wool portion appeared in a red shade. Both colors reportedly were clear and bright, proving that no cross staining had occurred.

References: same as those to USPat 2,772,943.

PRELIMINARY SHORT AGING OF PRINTS to Detect Defects in Printing D,2,04

USPat 2,777,748 (Riegel Textile Corp——Graves et al——Jan 15, 1957)

In printing, it is common among azodyes of the Rapidogen group or of dyes of the Indigosol group and related dyestuff classes (Spectrolenes, Pharmasols, Diagenes, Calconyls, Algosols, etc) that printing faults generally do not appear during the printing operation. They become visible only after developing by acid steam or aging. A great quantity of cloth is often spoiled before the mishap is detected.

The current method seeks to correct this with the placing an ager of reduced dimensions (a "miniature ager") adjacent to the drying device and working continuously in tandem with the printing operation. The ager is described as similar to the conventional type but of a substantially smaller size, for instance, 8′ high, 4′ wide and one foot deep. Cloth is passed through this device at a speed of 20-60 sec. A relatively small amount of dilute acid is injected to bring about preliminary color development in acid steam.

A further advantage is claimed for the ager in the handling of cloth that is correctly printed. In this event the partially aged goods need less steam and acid in the final aging. Also in this case, the aging time might be reduced by about 25%. It can be

further noted that strong alkaline preparations are immediately neutralized in the preliminary aging, thus preventing any possible damage in longer storage under alkaline conditions. The method reportedly is also helpful in aniline black printing to show immediately the frequently occurring streaks after the goods pass through the "miniature ager", which in this case is filled with neutral steam.

Among the references cited by the Patent Office:

USPat 2,174,227 (Arnold Print Works/1939) describes a printing machine connected with a small, acid-steam-filled unit to print and develop Rapidogen or similar dyes in a continuous operation. It can be inspected by the printer from his position without interrupting his work.

Rayon Textile Monthly of May 1945, pages 108(246) and 109(247), discusses the procedure for fixing stabilized azoic colors in screen printing by airing, neutral and acid steaming.

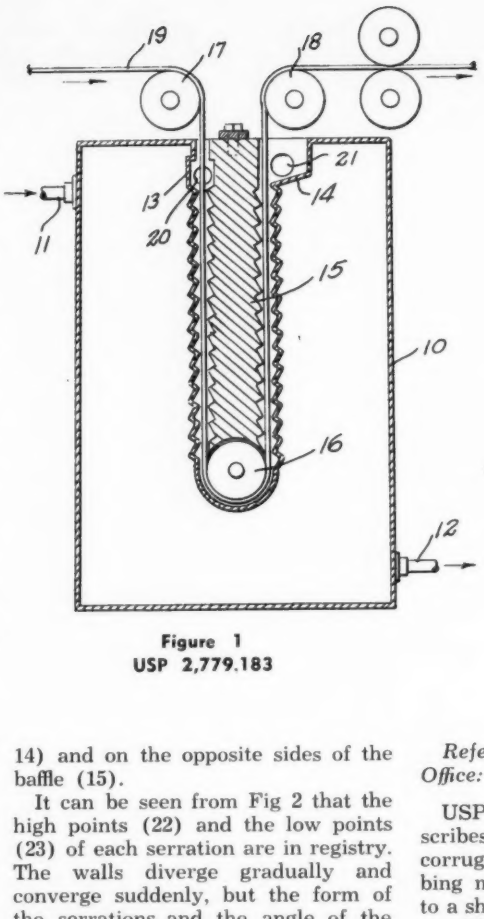


Figure 1
USP 2,779,183

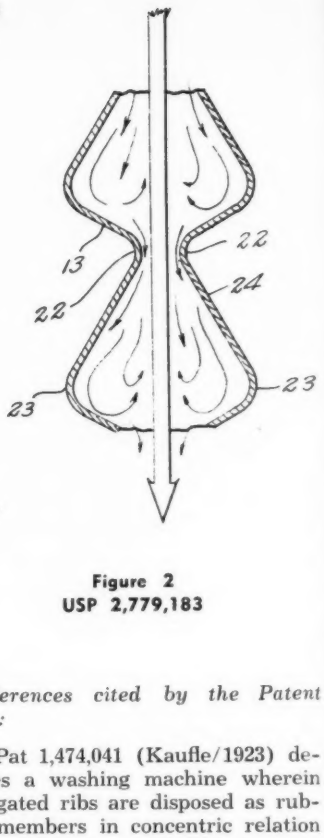


Figure 2
USP 2,779,183

APPARATUS FOR CONTINUOUS DYEING———Turbulence Created by Serrations C,6

USPat 2,779,183 (Fornelli——Jan 29, 1957)

The purpose of this device is to create greater turbulence and better penetration in continuous dyeing processes by means of a special formation of the walls of the dyebath-containing well (See Figure 1). The well is suspended in a container (10) fitted with inlet (11) and outlet (12) for hot water or steam. The volume of the well formed by walls (13) and (14) is reduced by inserting—as in the Williams Unit—a baffle (15), which reaches down to roller (16). The fabric (19) is carried over rollers (17, 16, 18) through the dyebath. The essential feature of the invention is that of serrations in the walls (13 and 14) and on the opposite sides of the baffle (15).

It can be seen from Fig 2 that the high points (22) and the low points (23) of each serration are in registry. The walls diverge gradually and converge suddenly, but the form of the serrations and the angle of the walls may also be changed inversely. In any case, the speed of the fabric will cause turbulence of the dye liquor in every pear-shaped chamber, as shown by the arrows, causing increased penetration provided sufficient room is available for the liquid's agitation.

The device can also be used for other liquid treatments, such as scouring or bleaching.

References cited by the Patent Office:

USPat 1,474,041 (Kaufle/1923) describes a washing machine wherein corrugated ribs are disposed as rubbing members in concentric relation to a shaft bearing similar ribs to exert a rubbing and compressing effect.

USPat 2,552,078 (Gen Dyestuff—Williams/1951) covers the well-known Williams Unit for dyeing and aftertreating of fabrics.

USPat 2,693,995 (Hannay, Kilby /1954) describes the Standfast molten-metal dyeing process with all details. Cloth first passes the dyeing liquor floating on the molten-metal surface.

General Calendar

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
Gordon Research Conference on Textiles, July 8-12, Colby Jr College, New London, NH

AMERICAN HOTEL ASSOCIATION
June 24-25 (Hotel Textile Purchasing Course, Cornell Univ, Ithaca NY)

AMERICAN OIL CHEMISTS SOCIETY
Sept 30-Oct 2, 1957 (Fall meeting, Cincinnati); Apr 21-23, 1958 (Memphis); Oct 20-22, 1958 (Chicago); Spring, 1959 (New Orleans); Fall, 1959 (Los Angeles)

AMERICAN SOCIETY FOR QUALITY CONTROL—TEXTILE DIVISION
8th Annual Conference—Jan 30-Feb 1, Clemson House, Clemson, SC

THE DRYSALTERS CLUB OF NEW ENGLAND
June 21 (Annual Outing—Wachusett Country Club, West Boylston, Mass).

THE FIBER SOCIETY
Sept 4-6 (Joint meeting with the Textile Institute—Hotel Statler, Boston, Mass)

NATIONAL COTTON COUNCIL OF AMERICA
October 2-3 (Chemical Finishing Conference—Statler Hotel, Washington, DC)

PHILADELPHIA TEXTILE INSTITUTE ALUMNI ASSOCIATION
June 6-8 (Alumni Day, Alumni Outing, PTI Commencement)

SOUTHERN TEXTILE ASSOCIATION
June 20-22 (Annual Convention—Ocean Forest Hotel, Myrtle Beach, SC)

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
June 11, Sept 10, Oct 8, Nov 12 (Palm Terrace Suite, Hotel Roosevelt, New York, NY)

News of the Trade

Interchemical Moves NE Headquarters

On May 20 the New England headquarters of Interchemical Corporation's Textile Colors Division moved to a new building at 201 Armistice Boulevard, Pawtucket, RI.

The new Pawtucket building contains larger offices, fully-equipped laboratories, and greater warehousing facilities for the company's Aridye® and Aquaprint® pigment colors and Interchem® dyes for the printing and dyeing of textiles.

The expressed purpose for the construction of the new Interchemical office-laboratory-warehouse building is to provide greater facilities for servicing textile printers and dyers in the New England area.

RPC Reorganizes to Control Quality of Syl-Mer Finishes

Refined Products Corp, one of several firms recently licensed by Dow Corning Corp to manufacture Syl-mer silicone emulsions for textiles, has announced a reorganization of its field technical staff as part of an expanded quality control program to assure proper end-use performance standards of the finishes.

Thorough laboratory testing of all fabrics processed with Syl-mer emulsions supplied by the firm highlights the program, Ralph Zoccolillo, general manager, reports. These are standard performance tests to make sure that treated goods stand up to claims of being resistant to water and water-borne stains.

The laboratory staff will coordinate its work with the company's 30 field technicians throughout the country under the supervision of A J Ramunda, director of the textile division.

In accordance with the licensing agreement with Dow Corning, Refined Products may use the Syl-mer name and familiar identifying trade mark in association with its own silicone finishes supplied to mills and finishers also licensed by the Midland, Mich company. Syl-mer tags and other sales aids will be sent cutters using the treated fabrics in their apparel and home furnishings lines.

Refined Products currently produces its silicone emulsions under the registered trade-names of Perma Silene and Perma Par W.

FRL Celebrates 15th Anniversary

The entire staff of Fabric Research Laboratories, Inc and guests celebrated the fifteenth anniversary of the founding of the laboratories at a dinner party held May 6 at The Lord Fox, Foxboro, Mass. More than eighty people were present.

At the head table were the three founders of the laboratories and their wives: Dr & Mrs Walter J Hamburger, Mr & Mrs Ernest R Kaswell, and Dr & Mrs Kenneth R Fox. Special guests were James F Farr, general counsel and member of the board of directors, and Prof Edward R Schwarz of Massachusetts Institute of Technology.

In fifteen years the organization has grown from a staff of three to a staff of 45 and from one floor of a Boston office building to an ultra-modern, 16,000 square foot laboratory and staff office building on Route 128 in Dedham, Mass.

Delhi-Taylor Oil Corp's Chemical Div to be on Stream Shortly

Harry W Dudley, general sales manager of Delhi-Taylor Oil Corp's new Chemical Division, has announced that the Division's new petrochemicals plant will go on stream July 1, 1957. Located in Corpus Christi, Texas, the $4,000,000 plant has ample facilities for water shipment. The Udex extraction unit, said Mr Dudley, has a capacity of 45,000,000 gallons per year. Initial production will include benzene, toluene, and xylene. Studies are presently well under way for the production of additional petrochemicals.

Mr Dudley, formerly with Pittsburgh Coke & Chemical Co, is responsible for the Chemical Division's sales, marketing, advertising, and new developments. The Chemical Division's Sales Office is located at 415 Madison Avenue, New York, N Y. The Main Office of the Chemical Division is in Corpus Christi, Texas.

Miss America of 1957 is shown cutting the ribbon at the opening of the 43rd Knitting Arts Exhibition recently in Atlantic City, NJ, Auditorium. The show, which ran through May 1st, attracted an attendance estimated to be 35% in excess of that at the 1955 exhibition, and also boasted the greatest number of exhibitors in its history.

Photo shows, from left to right, Ruben C Ball, vice president, National Association of Hosiery Manufacturers; Robert C McCabe, managing director, Underwear Institute; Robert F Gregory, president, Underwear Institute; Roy A Cheney, retiring president of the Underwear Institute; Miss Marian McKnight, Miss America, 1957; L W Rainard, manager, engineering section, Joseph Bancroft & Sons Co; Sidney S Korzenik, executive director, National Knitted Outwear Assoc; and Albert C Rau, manager, Knitting Arts Exhibition.

The KAE is sponsored jointly by NAHM, NKOA and the Underwear Institute.

Alco Appoints New West Coast Sales Agent

Appointment of a new West Coast sales agent has been announced by F M Tolin, sales vice president, Alco Oil & Chemical Corp, Philadelphia, Pa.

Effective immediately, Pacific Polymers, Inc, 12700 Cerise Ave, Hawthorne, Calif, will handle sales of the complete Alco product line, including Vulcanols (rubber latex compounds), Vulcacures (ultra accelerators), Trenamines (wetting agents), Alcogums (chemical stabilizers and thickeners), Vulnopols (short stops), and Trenisols (film-forming dispersions of plastics).

General Manager of Pacific Polymers, Inc is C H Churchill.

H-D Uses Bower-Bird Story in Promotion

A species of tropical bird which "paints" almost as skillfully in colors as humans is the theme of a promotional program just launched by The Hilton-Davis Chemical Company, Cincinnati.

Bower-bird is the name of the species of artistic birds found only in Australia and New Guinea. The name is derived from the fact that these birds actually build "bowers" from twigs and branches. The complete story of how they use colors as a lure, thereby preserving the species from extinction, was told in the March 25th issue of *Life* by means of a series of color paintings by artist Joseph Sibal, with commentary by ornithologist Thomas Gilliard.

Hilton-Davis has started an intensive advertising and direct-mail campaign based on the Bower-birds' use of colors "to attract", according to Nelson S Knaggs, Hilton-Davis' vice-president in charge of sales. The campaign makes the point that "color is a tremendous factor in increasing the sales potential of any product."

Surpassing even the ability to build bowers is the male Bower-bird's "fantastic and nearly human use of color to entice the female into its bower," notes Mr Knaggs. Some species paint the walls of their bowers with green or blue fruit pulp mixed with saliva, using their beaks or twigs as paint brushes. Others decorate with brightly colored feathers or living orchids. One species builds a cone-shaped bower and plants a colorful moss rug before it, arranging vivid fruits and flowers on the moss. Another displays coins, jewelry and other glittering objects stolen from humans.

Sole purpose of the bower and its colorful exhibits is to attract and hold the interest of the female in order to mate. The powerful attraction of color as a prerequisite in mating is known to be the reason for the survival of the Bower-bird species.

Mr Knaggs hit upon the idea of the Bower-bird story as a promotional theme after talking in 1956 to Mr Gilliard, a staff member of the Museum of Natural History in New York. Knaggs, vice-president of the Cincinnati Museum of Natural History and member of the Explorers' Club, then commissioned painter Joseph Sibal to do the paintings which are featured in Hilton-Davis' advertising and direct-mail literature.

Werner G Smith, Inc Forms Chemical Division

Werner G Smith, Inc has announced the appointment of John D Hetchler to manage the firm's new chemical division. The new division will be located in Cleveland and will manufacture new products which will expand the company's present line of sperm whale oils, fish oils, and core oils. Mr. Hetchler recently resigned as sales manager of the Chemical Products Division of Archer-Daniels-Midland Company.

Chemicals derived from oils and fats and chemically modified tall oils, animal tallow, sperm whale oils, and fish oils will be produced. Some of the products have never before been made commercially and will be used in synthetic fiber textile finishes and many other yet undeveloped industrial applications.

Seven Graduate Research Projects at Clemson

Seven projects, as many as the combined number in all previous years, are being completed this spring in the graduate research program of the Clemson College School of Textiles.

This is viewed by the department of textile chemistry, which conducts the research, as an indication of growing interest in the increasingly complex field, of new fibers, and new dyeing and finishing techniques.

Clemson awards the Master of Science degree in textile chemistry, and is unusual in offering an undergraduate thesis requirement. The undergraduate plan serves as an introduction to the fundamentals of research procedure for textile chemistry students planning graduate school work.

Currently, leading project research involves a method for improving strength, antishrinkage, and dyeing in wool by a new-type molecular cross-linking; a new series of modified starches for use as permanent finishes, and new properties in starch and cellulose from a unique epoxide-type secretion.

Studies are being made of practical effects of a new silicone compound on cotton and wool; light on a resin-pigment treated fabric, and cellulose with various vinyl compounds, in developing a modified cellulose.

The program of research on the chemical processing of cotton, and on developments through studies of cotton fibers was reviewed when collaborators met with research workers recently at the Southern Utilization Research and Development Division of the Agricultural Research Service, USDA, in New Orleans, La. Pictured during the conference are, left to right, seated: Nelson F Getchell, Technical Department, National Cotton Council of America, special collaborator for research on cotton soiling; Leonard Smith, director of utilization research, National Cotton Council; Benjamin Phillips, assistant director, Union Carbide Chemicals Co; J C Barnes, head of laboratory, Research Laboratories, Kendall Cotton Mills; George S Buck, Jr, technical director, National Cotton Council; and H Y Jennings, Director of Research, Dan River Mills, Inc. Standing: A Mason DuPré, Jr, special assistant to the director, SURDD; C M Conrad, head of the Cotton Fiber Section, SURDD; Walter M Scott, assistant to the administrator for utilization research and development, USDA; Carl J Malm, superintendent, Research and Development Department, Eastman Kodak Co Park Works; C H Fisher, director, SURDD; Fred Fortess, manager, Dyeing and Finishing Laboratory, Celanese Corp of America; F S Perkerson, head of Cotton Chemical Processing Section, SURDD.

Hotel Textile Purchasing Course

A Hotel Textile Purchasing Course to be held at Cornell University, Ithaca, June 24 and 25, under American Hotel Association sponsorship, will feature American Standard L-24 and its relationship to purchasing and service life of textile products.

Cosponsored by the Cornell School of Hotel Administration, the course will include a series of individual lectures, a round-table discussion session and a final examination. Certificates of completion will be awarded.

Speakers who have agreed to appear on the two-day program include Cameron A Baker, manager, Textile Research Department, United States Testing Company, who will discuss the test methods used in the L-24 Standards, Lewis A Bradley, AHA laundry and textile consultant, who will speak on the practical results of purchasing according to American Standard L-24; Philip J Deegan, technical service manager, Western Laundry Division, H Kohnstamm & Co, Inc, who will cover the subject of laundering and drycleaning; Alfred Silverman, vice president, Angelica Uniform Company, who will speak on Washable Service Apparel and L-24; and Jules Labarthe, administrative fellow, Mellon Institute of Industrial Research, on basic fibers and background of American Standard L-24.

This is the second Hotel Textile Purchasing Course to be sponsored by the American Hotel Association in 1957. The first was held January 14 and 15 at the State University of Iowa. The Cornell course is open to all institutional consumers, managers and housekeepers, as well as manufacturers and suppliers, teachers of textile and purchasing courses and technical personnel. Inquiries should be addressed to *American Hotel Association*, 221 West 57th Street, New York 19, New York.

1957 MCA Safety Achievement Award to National's Moundsville Plant

The Manufacturing Chemists' Association Safety Achievement Award for completion of the year 1956 with no lost-time accident was presented recently by M A Conner, vice president of National Aniline Division, Allied Chemical & Dye Corp, to L C Goode, plant manager of the company's Moundsville, W Va, plant. This is the third successive year for which the award has been presented to this plant.

The Moundsville plant of National Aniline has recently seen the completion of expanded facilities for production of Nacconates (National Aniline's organic isocyanates) as well as new facilities for enlarged production of aniline oil.

59th LTI Commencement

Governor Foster Furcolo of Massachusetts will receive one of the three honorary doctor of science degrees to be awarded at 59th annual commencement exercises of the Lowell Technological Institute Sunday, June 16. Other honorary Sc D recipients will be Paul F Clark, chairman of the board of the John Hancock Mutual Life Insurance company of Boston, and Professor Emeritus Herbert J Ball, former chairman of the Division of Engineering at the Institute.

The principal address at the 2:30 ceremony in Cumnock hall will be given by the governor, and Samuel Pinanski, chairman of the LTI board of trustees, will award master of science degrees to six students and bachelor of science degrees to 88. Seven of the graduates will be commissioned second lieutenants in the U S Air Force Reserve.

Judge David A Rose of Boston will deliver the address at the baccalaureate services that morning at 10:30 o' clock in Temple Beth El, Lowell.

• NEW PRODUCTS AND DEVELOPMENTS •

Dexene CS-15

Development of a low-cost substantive softener for use with all fibers, either as a self-softener or in resin finishes, has been announced by Dexter Chemical Corp, New York.

Dexene CS-15 is a cationic-nonionic agent being manufactured under a recently developed process, the company reports. It may be used either on the alkaline or acid side and is claimed to be compatible with a wide variety of thermosetting and thermoplastic resin formulations.

Because of its exceptionally even rate of exhaustion, Dexene CS-15 is said to insure uniform softness throughout the package or beam in pressure machines. It is recommended by Dexter as an excellent napping assistant and as a means of lubricating the fibers to insure high-speed cutting and sewing. Among other characteristics claimed for the product are: low chlorine retention, high resistance to yellowing and excellent solubility.

Arko Fluor Tint Softener OR

Arko Fluor Tint is the trade name of fluorescent colors which were recently developed by the Arkansas Company, Inc. When applied to woolen yarns at low concentrations, they are said to provide simple and positive identification. When examined under ultraviolet light, wool treated with these various tints show a characteristic shade, such as blue, yellow or yellow-green. The Arko Fluor Tints are said to be readily removable from the woolen yarn by a light scouring operation.

Softener OR is a new type of cationic finish which was recently developed in Arkansas Co's research laboratories. It is said to impart an exceptionally soft and lofty hand to knit fabrics composed of acetate, Acrilan, nylon, Orlon, rayon and wool. In addition, it reportedly has excellent resistance to yellowing under normal drying conditions.

Cibalan Navy Blue RL Conc

Identified as the 30th dye in the Cibalan series, Cibalan Navy Blue RL Conc is said to fill a long-felt need for a good navy shade of this dyeing type. Meeting all standards of the Cibalan group, the new dye is said to be easily shaded with other Cibalan colors to give fashion tones of uniformly good fastness.

Cibalan Navy Blue RL Conc reportedly imparts an attractive and bloomy navy blue, and builds evenly to a level shade with good yield through heavy depths. It is stated that no development or other aftertreatment is required to obtain its good light and washing fastness. Ciba reports that application can be made at all processing stages of the fiber in a neutral bath or, with the aid of Cibalan Salt S, in an acid dyebath. Reservation of cellulosic and synthetic fibers other than nylon is said to be generally good. The shade turns slightly redder in artificial light.

Resin CB

Availability of Resin CB, a new acrylic emulsion for use as a backing for carpets and automotive upholstery fabrics, has been announced by Jersey State Chemical Company, 59 Lee Ave, Haledon, NJ.

Currently being used in production quantities by a number of mills throughout the country, Resin CB is claimed by the manufacturers to be light and heat fast and extremely durable. The new product reportedly requires no curing, can't crack or become brittle and is said to have excellent pigment binding properties. It can also be used to produce a variety of films, soft to hard.

Polyester Resin Emulsion

Development of a new concentrated resin emulsion has been announced by Chemical Products Corp, Little Falls, NJ.

Used in aqueous solutions with catalyst, on glass cloth or matted glass fibers, Polyester Resin Emulsion reportedly provides a strongly adhering size, with superior, tough, shatter proof, noncracking, nondusting, nonfraying, nonsplintering properties. It is said to bind pigments, colors and fillers to the glass fibers with a strong durable bond. Its paleness permits good light transmission and minimum discoloration, it is stated.

Polyester Resin Emulsion reinforced with fibrous glass reportedly forms high-strength, flexible laminates and mats, light in weight, noncorrosive, with exceptionally high impact strength and electrical and heat resistance, and with good light transmission.

Trichloromethanesulfonyl Chloride

Stauffer Chemical Company, 380 Madison Ave, New York, NY, is now offering a new organic sulfur derivative, Trichloromethanesulfonyl Chloride, in research quantities.

The compound is a white solid, said to be stable at normal temperatures but readily sublimed. It is soluble in a broad range of organic solvents.

Preliminary investigations indicate that the chemical will find major use as an intermediate for the manufacture of dyestuffs, rubber chemicals, lube additives, and pharmaceuticals.

Because of its reactive nature, it is anticipated that the chloride will hold promise as an intermediate in many fields of synthesis.

Transcope Pneumatic Controller

Taylor Instrument Companies' new Transcope Pneumatic Controller is said to provide an extremely accurate, compact (6″ x 6″ x 4″) means of maintaining a given set point by relaying measured variables for subsequent corrective action via a final control element such as diaphragm valve, lever motor, etc. Its inherent characteristics are said to make the Transcope ideal for the varying time constants of modern processing and for short-span measurement.

New both in concept and execution, the controller reportedly makes unique use of the motion-balance principle through interconnected multiple bellows and springs acting on a common force plate. Primarily for back-of-panel-board application, the plug-in feature makes possible mounting to a separate manifold located either at the point of measurement or the point of control. The Transcope has an integral cut-off relay which makes this possible. It also offers a complete interchangeability of unit parts. Available with single, or multiple control responses, conversion from one to the other is said to be easily accomplished.

Taylor points out that highly desirable factors of installation and maintenance are the ease of alignment and quick response to adjustment, coupled with definite ability to "stay put." Clean design plus rugged construction, featuring stainless steel, brass and aluminum throughout, are said to account for a high degree of insensitivity to ambient temperature, and low air consumption. This also, is said to provide a virtually fume-, dust- and moisture-proof unit which can be mounted almost anywhere.

For further information, request Bulletin 98218 from the Taylor Instrument Companies, Rochester 1, N Y.

Tinopal* E

Geigy Dyestuffs, Division of Geigy Chemical Corp, Ardsley, N Y, is now offering an optical bleaching agent designed to produce brilliant clear whites on Dacron. The new product, known as Tinopal* E Liquid, further rounds out the Geigy range of whitening agents.

The advent of Tinopal E Liquid is said to avoid the necessity of employing chemical bleaching to obtain whites on Dacron. The results obtained with the new product are said to be far superior in brilliancy and clearness as compared with the results obtained by the older method.

One of the features stressed by Geigy is the application versatility, as Tinopal E Liquid can be successfully used under a variety of conditions. It is said to be practically unaffected by pH and may be applied in a Textone bleach bath, an antichlor treatment or in an oxalic acid/ammonium biflouride graphite removal operation.

It is also stated that Tinopal E Liquid has good resistance to washing, atmospheric fading, pressing, perspiration acid and alkaline spotting. Light resistance is good, and heat setting or subsequent treatment with melamine resin has practically no effect on the product's properties, it is claimed.

Although the product has affinity for nylon, acetate, Arnel, silk, cotton and rayon, the company does not recommend Tinopal E Liquid where they are used singly since there are other optical bleaching agents available which produce equal or better results with far greater economy. However, where any of these fibers are blended with Dacron depending on the weight and construction, it is said to be possible to secure good union results with Tinopal E Liquid.

A unique feature of Tinopal E Liquid indicated by the manufacturer is that, when applied to Dacron, its brightening effect is noticeable under artificial as well as natural light.

Diazamine Blue BRG Conc

Diazamine Blue BRG Conc is a new dyestuff in the Sandoz line of diazotized and developed colors. Developed with beta napthol, it provides a blue which is desirably greener in shade on viscose. It discharges a pure white by alkaline and neutral discharge methods. Wash- and lightfastness are said to be unusually high for a diazotized and developed color.

Sandoz leaflets T-736 and 736a are available for reference regarding properties of this dyestuff and appearance of representative dyeings.

• NAMES IN THE NEWS •

Bassill

John E Bassill, president of the American Enka Corporation, New York, will be the principal speaker and a recipient of the honorary degree, Doctor of Textiles, at the 74th Commencement Exercises of the Philadelphia Textile Institute to be held Saturday, June 8th.

Mr Bassill has served as president of four major rayon-producing companies. From 1932 to 1946, he held this position with Tubize Rayon Corporation, New York, later serving concurrently as chief executive of the North American Rayon Corporation, and American Bemberg Corporation, both of New York, from 1947 to 1949. He joined the American Enka Corporation as president early in 1950.

In addition to these posts, he was vice president, director and executive committee member of the Celanese Corporation following the merger of Tubize with that company.

Mr Bassill has also served as chairman of the Executive Committee, Rayon Producers Group; director of both the National Federation of Textiles and the Textile Research Institute; vice chairman, American Rayon Institute; and a member of the board of directors and Executive Committee of the American Management Association.

Thomas C Holst has been named to the sales staff of General Latex and Chemical Corp, Cambridge, Mass. He will serve as sales representative in the Philadelphia area.

Mr Holst previously represented Laurel Soap Mfg Co in the Philadelphia area.

William A Juenger has joined Stein, Hall & Co, Inc as a sales representative at its St Louis Branch office. He will be concerned with the sale of the Company's complete line of products.

Mr Juenger was a salesman for Thor Power Tool Company in St Louis for the past two years.

The retirement of **Hugh M Brown** as dean of the Clemson College School of Textiles will become effective June 30.

Dr Brown has served as dean since 1945, and prior to that time was head of the Physics Department.

He has expressed an intention to devote his efforts to textiles and other types of research in which he is interested.

Shields

William H Shields, assistant to the research director of Emery Industries, Inc, has announced his retirement after 32 years with Emery.

Mr Shields joined Emery's research staff upon graduating from the University of Cincinnati in 1925. He spent several years during the 1930's in Emery's New York and Charlotte, NC, sales offices, returning to the research department in 1941. In 1943, he was appointed assistant research director, heading Emery's Textile and Sanitone research department. He directed the planning and erection of Emery's Twitchell Memorial Laboratories, which were dedicated in 1955.

Shields is a member of the American Chemical Society, the American Association of Textile Chemists and Colorists, and the American Oil Chemists' Society.

Clifford F Rassweiler, president-elect of the American Chemical Society and vice chairman of the Board, Johns-Manville Corp, has been named to receive the 1957 Honor Scroll of the New York Chapter of the American Institute of Chemists.

The award, annually made to a chemist in the New York area who has made an outstanding contribution to the chemical profession, will be presented at the Chapter's annual dinner on Thursday, June 6, at the Hotel Commodore of New York.

Abrahams

David H Abrahams, formerly a chemist with National Aniline Div Allied Chemical and Dye Corp, has joined the New York laboratories of Dexter Chemical Corp.

Mr Abrahams had a teaching fellowship in organic chemistry at Lowell Technological Institute and a teaching assistantship in chemistry at Massachusetts Institute of Technology.

American Aniline Products, a unit of Koppers Company, Inc has made several reassignments affecting personnel of its Southern Sales Staff.

Joe T Bohannon, Jr, formerly manager, Chattanooga Branch, has been transferred to Sales Department staff headquarters in Pittsburgh.

Karl C Ruppenthal, formerly assistant to the Southern District Manager at Charlotte, N C, has been transferred to Chattanooga, succeeding Mr Bohannon.

Edward S Johnson has been transferred from the Chattanooga sales service laboratory to the position of sales representative covering accounts in Tennessee and northern Georgia.

Clarence W Angline has been transferred from the unit's office in Columbus, Georgia to the sales service staff at Chattanooga.

William A Geiler will join the Georgia sales staff this summer upon completion of a specialized training course at the unit's main laboratories.

Peter Bruinooge has joined the pigment, chemical and color division of the Sherwin-Williams Company as a sales representative for Sherdye textile printing colors. He will service textile processors in the Middle Atlantic and southern New England states.

Prior to joining Sherwin-Williams he was associated with the F H Levey Company, Interchemical Corporation and Sun Chemical Company.

Kiernan

Christopher L Kiernan has been appointed sales promotion manager of Nuodex Products Company, a division of Heyden Newport Chemical Corporation.

Mr Kiernan was formerly associated with the advertising department of Air Reduction Company and previously was assistant promotion manager of True Magazine.

An exchange of assignments by R M Joslin and W A Woodcock has been announced by Union Carbide Chemicals Co Division of Union Carbide Corp. Mr Joslin has assumed the duties of manager, Fine Chemicals Department, Union Carbide Chemicals—a position formerly held by Mr Woodcock. In turn, Mr Woodcock has been appointed sales manager, Industrial Chemicals, which was Mr Joslin's previous assignment.

On May 1, 1956 J Donald Charlton became president & general manager of Mobil Oil de Mexico, S A with principal offices in Mexico City. Prior to arriving in Mexico City on September 1, 1955 to undertake the duties of treasurer of the Company, Mr Charlton had lived six years in Colombia. While living in Medellin, Cali and Bogota, Colombia, he served first as process products engineer, then chief engineer, branch manager, and finally as marketing manager of Socony-Vacuum Oil Company of Colombia, from which position he went to Mexico.

Charlton

TECHNICAL LITERATURE

(It is understood that the following literature is available from the sources listed in italics).

TECHNICAL BIBLIOGRAPHY ON TEXTILE WET PROCESSING—*Royce Chemical Co, Carlton Hill, NJ*—A 12-page bibliography listing the major technical literature on textile dyeing, printing and finishing is offered to the textile industry.

The bibliography was compiled by the Manchester Library in Manchester, England, one of the world's leading textile industry centers. The list was obtained by special arrangement between the library and Royce Chemical Co officers.

P J Wood, technical director at Royce, has described the bibliography as being the most complete thing of its kind in existence. He noted that it lists all literature on the past 30 years of textile industry progress. He expressed the opinion that it would be an invaluable aid to researchers in the field.

In addition to making the work generally available to the industry, Royce plans to present it to leading industrial, public and university libraries in the US.

THE CHEMICAL INDUSTRY FACTS BOOK (3rd Edition)—*$1.25, Manufacturing Chemists' Association, Inc, 1625 Eye Street, NW, Washington 6, DC*—This 160-page basic reference work on the chemical industry contains 15 chapters ranging from "The Industry's Role in the Economy" to such specifics as "Chemicals and Nuclear Energy."

Profusely illustrated with charts, graphs, and tables, the third edition of the Facts Book updates information on virtually every facet of the industry. About 100,000 copies will be distributed either by chemical companies or directly by the MCA. It is anticipated that one of the principal uses of the Facts Book will be in schools and colleges as a supplementary text and reference work. A 20-page Teacher's Guide prepared by Dr John S Richardson, president, National Science Teachers Association, is available free to educators for use with the Facts Book.

The single copy price of The Chemical Industry Facts Book is $1.25, postage prepaid. Discounts are available on bulk quantities.

FINANCIAL APPROACH TO INDUSTRIAL OPERATIONS—*$1.50, Research Div, Society for Advancement of Management, 74 Fifth Ave, New York 11, NY*—Financial decisions are the heart-beat of progressive management in today's highly competitive economy. All decisions in the industrial enterprise are financial, it is claimed.

The author, Alvin Brown, vice president for finance and director, The Johns-Manville Corp, delineates the sound principles governing: when to spend, who should make the decision to spend, how the decision should be reached, how much to spend, and how to determine exact returns.

Alvin Brown shows how the function of financial analysis may facilitate the solution of managerial problems generally. He discusses these problems in simple, fundamental terms and in a very stimulating manner.

WHITER, MORE-DYEABLE ORLON STAPLE AND TOW—*Bulletin OR-75, Du Pont Textile Fibers Technical Information, Technical Service Section, Textile Fibers Dept, E I du Pont de Nemours & Co, Inc, Wilmington, Del*—The term "whiter, more dyeable," used to describe improved Orlon acrylic fiber staple and tow, does not imply major differences in dye requirements or costs of dyeing, it is reported in this bulletin. Considerable confusion in the trade has been encountered on this point, according to Du Pont.

OR-75, which supplements Bulletin OR-51, reports that the saturation value of Orlon has been increased by about 30 percent, so that a greater amount of cationic or basic dye can be applied, and that the rate or speed at which cationic dyes are absorbed is about 30 percent greater.

"There has been no change in any of the other dyeing characteristics of the new merge," the bulletin states. "Its dyeability with disperse dyes is unchanged; its resistance to staining by either acid or direct dyes is the same or slightly better; its receptivity for various finishes is unchanged."

The bulletin points out that the improved dyeability permits better results in deep shades, particularly when the highest attainable dyeing temperature is approximately 205° F. Richer and deeper shades of black, navy, maroon, cordovan, brown, and hunter green can be obtained, frequently with reduction in dyeing time, it is stated. With deep shades, it is reported possible to save 10 to 20 percent of cationic dyes in formulas in which incomplete exhaustion caused waste. No reduction can be made, however, in dye formulas which have been giving complete exhaustion. In addition, it is stated, the amount of dye retarder used must be increased by 50 to 75 percent to insure leveling of light shades produced with cationic dyes.

The new material reportedly makes significant improvements in beck dyeing of woven piece goods as the result of the increased dyeing rate and increased saturation level. Dyeing time requirements for woven piece goods have previously been considered excessive.